SCIENTIFIC AMERICAN

April
1933

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a Copy

Machines That Think

By THOMAS ROSS

Can Human Thought Be Demonstrated By Mechanical Means?

•

BUILDING MODEL STARS

By Henry Norris Russell

•

MILK IN ITS PERFECT FORM

By O. Erf

•

WHAT IS TELEPATHY?

What have you learned today in the New University?

Talk with almost any woman and you will find her amazingly informed on vitamins, balanced diets, refrigeration, household sanitation, labor saving, family hygiene, table and home decoration. Watch her during her day and you will find her employing this new knowledge for the improvement of living.

Talk with almost any man and you'll find him technically informed about motor-cars and adding machines, aeroplanes and radios, telephones and oil-burners.

What has happened? It seems that people know more than they used to and that they use their new-found knowledge to their comfort and happiness. Perhaps this is the explanation: There is today a New University—the University of Advertising. Its doors never close, it is open to all and the fees of admission are the price of this magazine. The subjects taught are ways to make life better and more enjoyable. Eminent authorities in the various fields work with skilled writers and illustrators to prepare the daily "lessons"—the advertisements. They are admirably printed and illustrated. They are studied and applied, *as needed,* by the youngsters and grown-ups of all ages.

What have you learned in the New University? Study the advertisements. Useful knowledge is waiting there.

SCIENTIFIC AMERICAN

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EIGHTY-NINTH YEAR • ORSON D. MUNN, Editor

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SCIENTIFIC AMERICAN DIGEST

An index of articles appearing in back numbers of *Scientific American* is to be found in The Reader's Guide, Industrial Arts Index, Engineering Index, and Dramatic Index. These can be consulted in any large library.

ACROSS THE EDITOR'S DESK

AT the moment of going to press, we have already received a gratifying number of responses to the telepathy test proposed in our March number. It is, of course, too early as yet to venture even a guess as to the final results, but they will be published as soon as sufficient returns have been received and studied. In the meanwhile we are presenting in this issue, page 214, an article on telepathy, which clears up many misconceptions that have grown up around the subject. There will be other articles, other tests, more research. You will surely want to keep in touch with this intriguing subject which will be dealt with each month in SCIENTIFIC AMERICAN for some time to come.

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WAR DECLARED! Ominous words; tragic words if our country were forced to be a participant. As newspaper headlines, they would be followed by sub-heads such as: "Nation unprepared; Island possessions of U. S. captured in quick surprize attack; Fleet, outclassed by enemy's, scattered—will require months to condition and concentrate; Merchant fleet blockaded, shipping lines cut, supplies badly needed; Nation faces months of feverish naval construction." Few realize how true these comments would be if we were forced into a war. And such a war is imminent unless we take steps to prevent it. In an early issue an article will be presented which makes a direct approach to this timely subject. The article dares to tell many startling facts concerning the great danger that threatens the United States and the peace of the world—unless. . . . It also tells the whole background of the danger, what we must do to avert war, and condemns in no uncertain terms those who threaten world peace.

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Readers of SCIENTIFIC AMERICAN will remember the psychic investigation conducted several years ago, and especially that engaging medium Margery, whose "physical phenomena" failed to convince the committee that they were of spiritualistic origin. What has happened to Margery? Occasionally she breaks into print in the daily papers, but little of a definite nature has been available to the public since 1925. In the intervening years, events of importance to those interested in psychic matters have happened. Accordingly we have asked Dr. Walter Franklin Prince to prepare a summary of the Margery case from the point where it was dropped by the SCIENTIFIC AMERICAN committee in 1925 up to the present day. He has done so, and his article is scheduled for next month. Dr. Prince tells of startling evidences of fraud, that fall in line with the original findings of our committee. This is one article that you won't want to miss.

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Reclamation of arid lands along the Nile in Egypt continues apace. The original work at the Assuan Dam has been successful, and now the Nile is to be utilized throughout almost its entire length; a series of dams is being built to impound water and divert it to irrigate a vast acreage of arid but fertile land. The project is amazing in its great scope and significant in the economic benefits expected to result. We have arranged to obtain an account of the job of engineering this project, written on the site of the work, and expect to have it ready for an early issue.

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Each one of us carries with him the world's most efficient pump—the human heart. It runs during an entire lifetime, without the loss of even a few consecutive minutes for repairs; it can tolerate an enormous overload, even for days at a time; it can be accelerated to three or four times its normal speed and still keep going; if the valves leak, it will increase its efforts to compensate. Since it does all these things unobtrusively, it is often abused. Even so efficient a machine as the heart can be broken down by improper treatment. Col. G. A. Skinner, of the Medical Corps, U. S. Army, has, therefore, prepared an article on sane care of the pump on which our very existence depends. It will appear in a coming issue, and will put forth facts that no one can afford to ignore.

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An article on gliding—motorless flight—has been prepared for us by Arthur L. Lawrence of the Glider Section of the Rhode Island Aviation League. Himself a glider pilot, he tells in an interesting and non-technical manner about the aerodynamics and meteorology that make possible sustained flight in a motorless plane. Reading this article is the next best thing to experiencing the thrill of riding with wings of silence on the currents of the atmosphere.

Editor and Publisher

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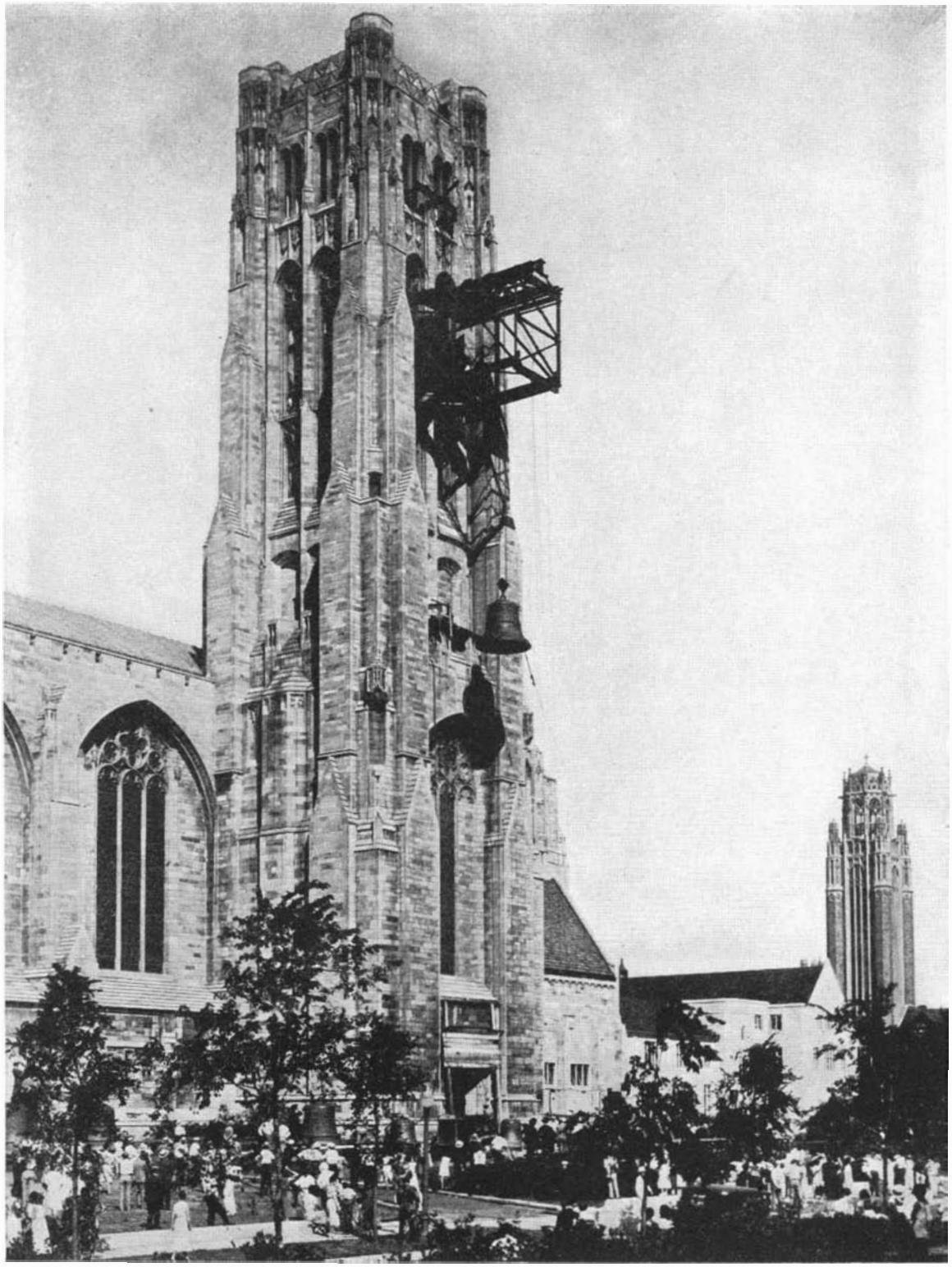
EDWARD BAUSCH

THERE are numerous business enterprises in this country which are also virtually institutions of scientific research, having a direct effect on the advancement of science just as the universities do, and the Bausch and Lomb Optical Company is one of them. Its keen and willing cooperation with the War Department and with various physicists at the time of America's entry into the World War, when it suddenly became necessary for our nation to teach itself in a hurry what no American then knew—how to make good optical glass—alone gave this organization that standing.

Though others have very greatly helped to build the Bausch and Lomb industry, Edward Bausch, whose photograph is reproduced above, has been its strongest pillar for half a century, and at the age of 78 he still actively guides it, being its president today. It was his father, John Jacob Bausch, who came to this country from Germany in 1849 and founded the firm, taking Henry Lomb into partnership. At that time they made only spectacles and lenses but the young lad Edward, then 14, pottering around the shops and deeply intrigued by everything optical, made a low-powered microscope (shown at the side). Then he entered Cornell University and returned equipped with much of the necessary optical theory to design high-powered microscopes. He organized microscope making in the firm and has actively sponsored it ever since.



A CARILLON WHICH WAS HOISTED BY TRACTOR

IN hoisting the 72 bells of a carillon which was presented to the University of Chicago by John D. Rockefeller, Jr., in memory of his mother, a Caterpillar tractor was used as the motive power. Each bell was hoisted up to an outrigger on which there was a car which swung the bell inside the tower. Special care was necessary so that bells would not be chipped by bumping. The bell shown, weighing 18½ tons, took six minutes 35 seconds from the time it started to rise from the ground until it was landed on the car on the outrigger. Several other bells are shown on ground; the tractor is in doorway.

A glimpse into the future: air conditioning makes an unlivable room—in the basement—livable. This new process, developed for human comfort and efficiency, is seen as one of the important factors in our future prosperity, especially when applied to private homes such as this

THE ECONOMICS OF MAN-MADE WEATHER

By WILLIS H. CARRIER

LESS than a century ago farm laborers who toiled from dawn to dusk at 75 cents per day rioted and destroyed the first mowing machines. Poorly paid spinners and weavers wrecked some of the first spinning jennies and power looms in England.

At this time we again hear the cry of those who would place upon the "machine age" the responsibility for unemployment and economic instability.

The mobility of labor and the flexibility of industry as well as the stability of credit, to avert recurrence of these conditions, is a problem yet to be solved. The immediate situation imposes a crying need for new industries which will contribute wealth and employment in a degree comparable to that produced by the automobile, the radio, and the household refrigerator. In the anxiety to identify such a bright spot, some economists have pointed to the field of air conditioning. Although I do not feel that this new industry or any other single industry can be called upon alone to produce an immediate and miraculous recovery, it is my own opinion that air conditioning will contribute substantially, in numerous direct and indirect ways, to business improvement and to the maintenance of the tempo of our advancement.

Climate has always exerted a dominant influence upon the destinies and advancement of the races. Ages ago we learned to heat the air and thus make it possible to inhabit, throughout cold seasons, sections of the earth which otherwise would have been forbidding. But temperature is only one phase in our new command of the conditions of the air which surrounds us. We have also learned to clean the air, to free it from dust and objectionable foreign matter. We have learned to establish and control any desired condition of humidity—which is just as important to our comfort and health as the temperature of the air. In summer, we can by de-humidification relieve the muggy oppression of humid days; in winter, we can add moisture to the air to alleviate that parching, arid condition common to the artificially heated, but un-humidified home or office.

MANUFACTURED weather found its inception in the demands of industry in order that the manufacturing of certain weather-sensitive products might be independent of weather, seasons, or geographical locations.

In a South American mine, 7000 feet below the surface of the earth, temperatures exceed 120 degrees, Fahrenheit, and the air is almost saturated with moisture. Air conditioning equipment, placed in the workings, has corrected this condition, brought humane comfort to workers, and allowed the work to proceed efficiently to the profit of the owners.

While textile mills at one time could be successful only in regions having a naturally moist climate, great mills are operating today in the cotton fields near the source of supply because air conditions best suited to each manufacturing process are maintained within the mills by modern air conditioning equipment.

Air conditioning is applied to a great variety of industrial processes and, therefore, there is necessary a wide diversity in the character and method of its application. In some installations the primary purpose is to produce a humid climate with only a reasonable degree of temperature reduction which, though of practical advantage, is merely incidental. In many other cases, a rigid control of temperature with a lowering of the relative humidity is required.

This last-mentioned type of air conditioning has a much larger field as it applies to all processes that are affected by temperature as well as humidity. This is true in the manufacture of confectionery, in modern bakeries, in the manufacture of cigars and cigarettes, and in lithographing. It is used in the automatic packaging and wrapping of goods and in the drying of certain products at low temperatures, such as

photographic films, chewing gum, and summer sausage. It is used successfully in many processes of the manufacture of ceramics from terra cotta to tiles and dishes. The Simonds Saw and Tool Company, Fitchburg, Massachusetts, have applied it as a necessary adjunct to their windowless factory where saws are to be manufactured under artificial light and artificial ventilation, maintaining ideal conditions regardless of external conditions.

More than 200 industries have already found air conditioning an indispensable servant, freeing the progressive manufacturer from daily weather uncertainties, improving the quality of his product, and contributing to the health and efficiency of his workers.

In general, industrial applications of air conditioning are warranted whenever the tangible or direct savings will pay for the cost of the installation within three years. Frequently economies effected by air conditioning installations are almost startling. In the case of one ceramic manufacturer, it was found possible to double his production without increasing his factory floor space as he had intended. The cost of a relatively small air conditioning equipment was only one fifth of the cost of the proposed increase in building. In addition, the quality of his product was improved and the reduction of losses in production more than paid for the equipment every year. To give another example, a large tobacco manufacturer saved in one department, by the reduction of the amount of scrap tobacco, enough to pay for the initial cost of the equipment six-fold in one year.

An interesting study has been made by the Philadelphia Electric Company in one of the factories of the American Cigar Company. The object of the study was to determine the benefits derived from refrigeration equipment added to the existing air conditioning system by which the plant was enabled to maintain desired conditions of humidity and temperature in summer as well as in winter. It was found that the investment in this addition to the installation amounted to 34,000 dollars. The gross savings for a single season in but one of several departments which were served amounted to 29,546 dollars.

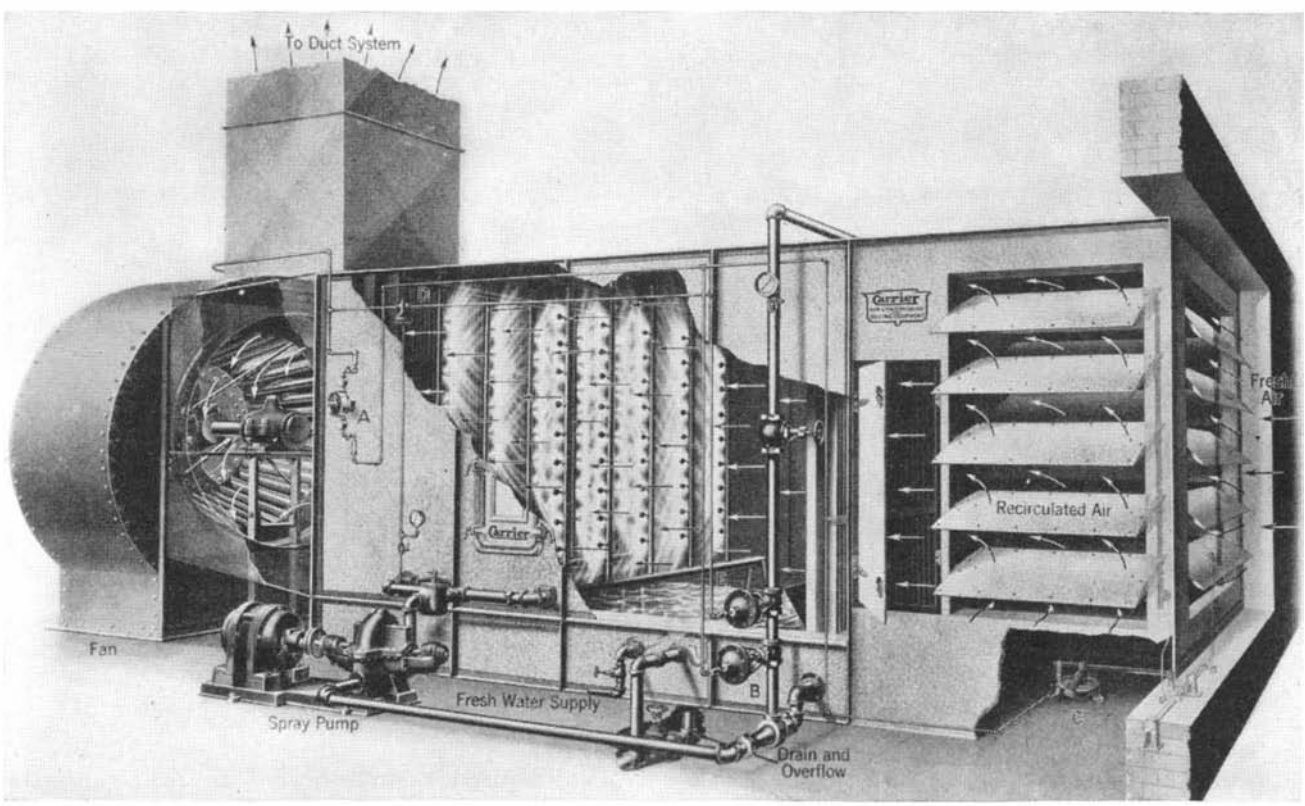
As industrial air conditioning installations are increasing, the savings to industry are increasing in proportion. If we may estimate the present value of industrial applications of air conditioning in this country at 30,000,000 dollars, then under normal conditions they are probably producing economies of at least 15,000,000 dollars annually.

It is axiomatic that if the over-all labor requirements were not reduced then there would be no purpose in applying air conditioning to industry or, in fact, in applying any other improvement. It must be admitted that air conditioning as applied to certain branches of industry does reduce the labor requirement of industry as a whole except for one feature. Lower cost of production results in lower prices and increases the demand for a product, as in the case of rayon where air conditioning and refrigeration are indispensable for low cost production. Thus, increased consumption may to some extent offset the labor reduction resulting from the lowered unit cost.

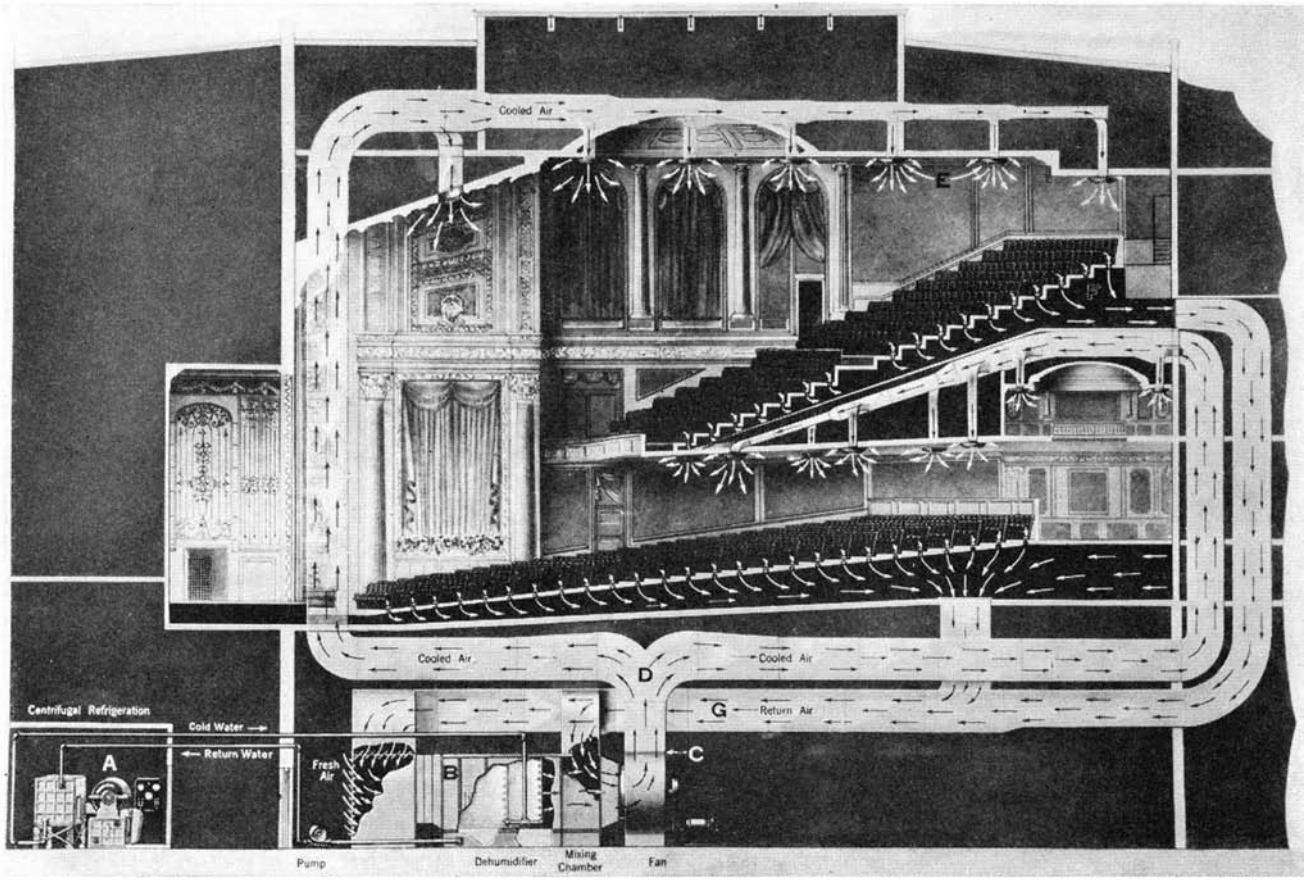
There is another field of air conditioning which creates a new demand, a new market, and has the possibilities of much more than making up for the economies in labor resulting from the application of air conditioning to industry. I refer to air conditioning for human comfort. This is a new and most fascinating field, and it is this field which, to my mind, has the greatest potentialities for making air conditioning a great industry.

Although the basic principles and practice of air conditioning have been well known for more than 20 years, it is only within the last eight years that its vast importance in increasing human comfort and efficiency has begun to receive public acceptance.

As a pioneer in this particular field, as well as in the general field of air conditioning, I am naturally enthusiastic concerning its future prospects. Any economic predictions that I may make might well be prejudiced, but I find that I have plenty of excellent company. Others who view the possibilities of the industry from the outside often outdo me in their enthusiasm concerning future possibilities in this field.



The air conditioning system for a theater, showing spray chamber, the fan, and automatically controlled air dampers. Air passes through a spray of atomized water which cleans and purifies it, and also cools it in summer or humidifies it in winter



The interesting air distribution system of a theater. Conditioned air passes from the "weather-making" equipment through ducts to the ceilings of auditorium and balcony and is "poured" out. Other ducts return the vitiated air to the apparatus

Any device which will increase man's comfort and his satisfaction with his surroundings tends to increase his efficiency, whether in the factory or in the home. Further, if such a product actually improves the conditions affecting his health, and decreases the fatigue from his day's labor, then its economic advantage is unquestionable, providing it can be produced at a cost commensurate with the returns. In other words, it must pay its way either through increased productivity or through increased comfort and health.

What are the returns in air conditioning? The first installation of air conditioning in a theater in New York City in 1924 paid for the entire installation the first summer that it was operated. It increased the summer attendance fully 50 percent and the average yearly attendance from 12 to 15 percent while the cost of air conditioning varies from 5 to 10 percent.

In the department store, air conditioning pays its way. The lower floor and basement where nearly one half the sales are made are usually conditioned. The cost of owning and operating an air conditioning system is less than one-half of 1 percent of the total sales for the year. Since it is the summer sales that are chiefly increased, it requires less than a 2 percent increase for a three months period. Judging from the results of air conditioning at Macy's, as an illustration, the increase in purchasers, and presumably the increase in sales, during this period is several times this amount.

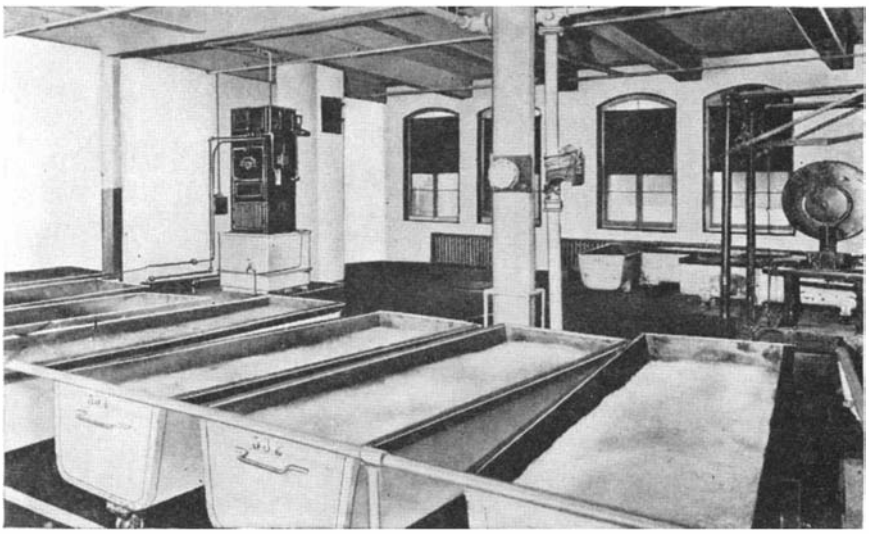
I am confident in predicting that within a few years the office building that is not air conditioned in summer as well as in winter will be wholly obsolete. Today air conditioning is being applied to entire office buildings at an owning and operating cost of from 18 to 25 cents a square foot of rentable area. Not all of this increase in cost, however, is chargeable to the air conditioning equipment, as a certain expense for ventilation and additional heating would be required in any event. It is probably fair to say that the increased cost of owning and operating due to air conditioning would be from 14 to 20 cents a square foot annually.

IN these days of competitive building, an average of 80 percent occupancy may be considered quite normal. If the addition of air conditioning will increase the occupancy 5 to 10 percent it will pay for itself without any increase in the rental rates. On the other hand, when the building is satisfactorily rented, the cost of owning and operating would be met by an increase of rental of from 14 to 20 cents a square foot. There are also other advantages to the building owner. The cost of cleaning and renovating is reduced practically one half due to the fact that windows can be kept closed, dust excluded, and only clean air used.

The Metropolitan Life Insurance Company, after making a thorough study of the possibilities, have air conditioned their new 33-story office building for their employees in New York City from top to bottom. Thirteen hundred tons of refrigeration—equivalent to that supplied by 1300 tons of ice daily—with a demand load of over 1500 kilowatts for the entire conditioning plant are required.

Indeed, it seems quite possible that air conditioning for human comfort will realize calculable as well as intangible returns that are fully as great as those realized in manufacturing. Whether we will ever come to windowless offices, artificially lighted and completely air conditioned, I do not know, but such construction on the first 15 floors of city buildings would certainly be made practicable by air conditioning, and very probably desirable.

The railroads and the Pullman company are now looking forward to completely conditioned trains in practically all parts of the United States. Within a very few years we will scarcely consider taking any extended railroad trip in summer, either by day or night, unless we ride in perfectly cooled and air conditioned cars free from dust and noise. Railroads look upon air condi-



In bakeries, air conditioning has proved of inestimable value. Here is shown at left a unit air conditioner in the dough fermentation room of a large bakery

tioning as a means of increasing the sum total of traffic by reducing the amount of diversion to other modes of travel. In this they are undoubtedly correct. As in the case of the theaters, when one road starts, the others must follow. I have had the personal satisfaction of designing the first mechanically air conditioned car ever operated on a railroad—the diner, "Martha Washington" on the Baltimore and Ohio, and the Baltimore and Ohio may claim the honor of being the first railroad to demonstrate the practicability of air conditioning in passenger service, although they are run a close second by the Santa Fé and the Missouri, Kansas and Texas.

THE latest improvement which increases the practicability of the application of air conditioning to railroads is the use of train line steam directly for cooling the water used in air conditioning.

We have reviewed the possibilities of air conditioning with respect to the user. Let us now examine its economic possibilities as an industry from the standpoint of the manufacturer. First of all, there is the air conditioning chamber itself, using either heat transfer surfaces or sprays in which the air is either heated or cooled, humidified or de-humidified, and cleaned of dust or other impurities. In addition, there are many parts required from other manufacturers: air heaters or radiators, fans, pumps, cooling towers, and temperature and humidity controls. In addition, there usually must be fabricated on the job sheet metal ducts, either with or without insulation, for the distribution of the conditioned air; special registers and outlets for the admission of the air to the rooms. Most important, is the engineering service required for the proper application of air conditioning to various requirements and to various types of building construction. Thus, it gives employment in many factories as well as in the field.

Every growing industry which has been carried on over a number of years has a growing rate of doubling. The period for doubling in air conditioning has been about every four years. The indications are that the future growth for some years may be expected to be as rapid as during the past 17 years due to the fact that it is really an infant industry.

On the assumption that the present growth alone may be maintained for the next 20 years, we may reasonably expect an industry of over 300,000,000 dollars annually in 1952.

Translated in terms of employment from the mine or factory to the consumer, it means the employment of over half a million additional people in the manufacture and installation of equipment, to say nothing of additional employment given to others in operation, maintenance, and in power production.

The value of the air conditioning load to the power companies is indicated by the fact that the annual power consumption corresponding to the cumulative sales of equipment would be more than one sixth of the annual sales of equipment in the corresponding year, although the increase in power consumption for any year is less than 2 percent of the corresponding equipment sales for that year. Such a projected advance in air conditioning would mean an increase in power consumption for the United States nearly equal to the total now supplied to the whole New York metropolitan district.

A further advantage to the power companies is that it is also a desirable type of load. The summer electricity demand load is at present about 75 percent of the winter load, while the air conditioning load is predominately a summer load. An addition of one third to the present summer load, if it were possible, would probably greatly increase the economy of power plant operation and thus increase profits to the power companies as well as reduce the rate to the users.

AIR conditioning applied to human comfort not only contributes to human welfare but creates a new and rapidly increasing demand usefully aiding and taking up the slack of unemployment in technological advance in this and other fields. It may be the key to the successful exploitation of the wealth of the tropics. As an industry, it is yet in its infancy, and of its possibilities the surface only has been scratched. Upon the development of industries such as this our future industrial and social progress and well-being depend.

In processing tobacco it is important that the leaves do not dry out and cause dust. Conditioned air, from the overhead duct, "conditions" tobacco here

OUR POINT OF VIEW

Repercussion

BIGOTRY is a form of mental disorder, possibly not from a medical standpoint but in human associations. The man who persistently rides a hobby or blatantly continues an argument when he is diametrically opposed to preponderant authority on the subject, places himself in a class where few will be impressed with his mental processes.

Some time past we made a thorough and extended investigation on the use of aluminum cooking vessels and found that there is no danger attached thereto. We again repeat and emphasize that statement. In this finding, we are supported by the American Medical Association, Rockefeller Institute, the Mellon Institute, the Federal Trade Commission, and innumerable physicians and doctors of highest standing. We thought the matter was settled. Recently, however, by sly propaganda from several inconspicuous sources, the old cry of danger is repeated, the basis of the arguments being obtained from standard medical treatises by quoting only parts of a reference, leaving out the main body of the quotation which qualified the sentences used, thus entirely misrepresenting the sense of the reference. Such tactics confess the weakness of any contention. Distorted reasoning never won any argument.

Naval Reservists

THERE is one angle to the adequate navy question about which few concern themselves. This is the imperative need for trained officers and seamen available for instant service at the outbreak of war. Naval activities of every sort would have to be expanded tremendously and, as was pointed out in a February editorial, practically all active vessels of the Navy are now under-manned. To take care of the expansion and the personnel deficiency, at least 10,000 well-trained officers and men would be required immediately should hostilities begin.

The Fleet Naval Reserve, which corresponds to the National Guard units of the Army, has the necessary officers and men—in training and efficient. In the past, all of these have been kept in trim by weekly drill periods totaling 48 a year, but the Navy Bill for this year allows only enough money to pay the men for half that number of drills. Short-sighted Congressmen seem to consider that the training of these patriotic men on whom we should have to depend in time of war is less important than the saving of a mere 600,000 dollars—less than 0.02 percent of the total federal budget! It is obvious that if their drill periods are cut so rigidly, these men can not be so efficiently trained as heretofore. Not only that, but it will be more difficult to sustain their interest and keep units intact with only two drill periods a month.

By itself, this slash may not seem so vital to the average person, but as a part of the whole witless program of a few Congressmen to destroy every last vestige of national security, it is a national calamity. An adequate Navy, adequate reserves for both the Army and the Navy, preparedness to prevent war—when will the public see the light and, seeing it, reflect a few rays into the dark chambers of Congress!

Railroads

A YEAR ago, the railroads were granted permission to increase their freight rates—for the emergency—on condition that they would pool the additional revenue to form a loan fund for the weaker companies. At this writing, the railroads, in hearings before the Interstate Commerce Commission, are arguing their case for a continuation of the "emergency rates" after the scheduled date of their expiration on March 31. Since these common carriers, despite rigid economies and strenuous efforts in every direction, have had a most difficult time making both ends meet, it is to be hoped that the higher rates will be allowed to continue.

Early reports, not yet definite, indicate that the net railway operating income for the year 1932 was only 1.21 percent on their property investment, a drop from 1.98 in the preceding year. According to R. H. Aishton, President of the American Railway Association, "Net income, after fixed charges, disappeared in the railway industry in 1932. For the carriers as a whole, the aggregate net deficit was close to 200,000,000 dollars." Even the emergency rates have yielded only 60,000,000 dollars instead of the expected 100,000,000 to 125,000,000 dollars.

We shall not pile up statistics of railroad operation here—they are all bad—nor shall we repeat arguments as to the importance of our railroads, for this has been done time and again in these pages. People are already familiar with the sufferings of the railroads through several very lean years; similarly, they are familiar with the fact that the railroads are vital to our scheme of things. No need to repeat details. With everyone talking taxes, however, it is most interesting to note that in 1932, the railroads paid 40 cents in taxes out of each dollar of net operating revenue. "This means," according to Dr. Julius H. Parmelee, "that two fifths of the rail transportation properties of the United States were operated in 1932 for the benefit of state, federal, and local governments." Could anything be more significant of the railroads' difficulties?

Book Readers

FROM the American Library Association comes heartening news. People are reading more than they ever have before; circulation of books in many libraries has jumped more than 200 percent and the number of borrowers has increased correspondingly. Moreover, they are reading more educational, informative, provocative books, for figures show that of the total borrowed, books of fiction have declined from 16 percent in 1904 to 11 percent in 1926 and to 9 percent in 1933.

It may be that the depression has a lot to do with the increased circulation and the increase in number of borrowers. Lacking money, perhaps, to buy as before, people are turning to libraries for reading matter. If that is the explanation of the increase in borrowers and in books circulated, the figures pertaining to these increases mean very little. They would indicate simply a natural result of difficult times and nothing more.

The declining rate of fiction borrowing seems, however, to have greater significance. Classics are still on library shelves and new fiction is being ground out in about the same old style and volume, so we can't lay the decline to a recent lack of quality. Perhaps, therefore, people are becoming more serious-minded. Perhaps they are tired of the froth and frivolity, the preachments and canned cynicism of so-called popular fiction. Perhaps they intend to look into the deeper things of life, into the lives of great men for the lessons to be learned thereby, into science that has made of America one of the truly great nations of the earth. Whatever it is, it may be considered a hopeful sign; the trend to serious books gives some promise for the future of America.

A typical Safety Lane with headlight-testing section at the right

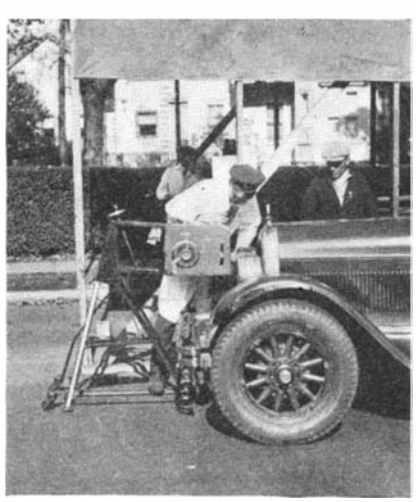
'Safety Lanes' for Motor Safety

By A. P. PECK

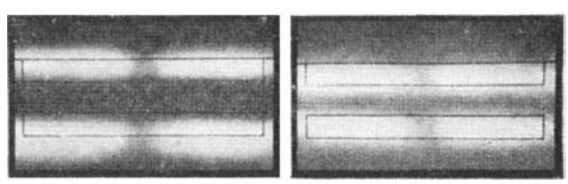
IF every motor car in this country should suddenly develop perfectly adjusted and equalized brakes, properly tilted and focused headlights, wheels in correct alignment, and steering gear, horn, and windshield wiper that function as they should, accident statistics would show a startling but pleasant drop. Of course, no motor-car driver intentionally causes accidents, but he may neglect to keep a careful check on the operation of the various important parts of his car. Then changes take place that are so slow that he does not realize the importance of them, and suddenly the accident happens. Was it faulty brakes? "Of course not," he answers. "They worked perfectly just a few moments before. Why, I haven't had to have them adjusted for the last 10,000 miles." Did his headlights blind the on-coming driver? "Impossible. They have been in perfect adjustment ever since I bought the car. How could the adjustment possibly change?"

Brakes will wear and become unequalized; headlights will change their adjustment; steering wheel play will develop insidiously; wheel alignment will change without the knowledge of the driver. How then can the motorist be induced to keep his equipment in proper operating order and thus create a condition of safety on the highways? Compulsory inspection is one answer, but the results are not always satisfactory. Another method is to provide a means whereby the operator may have the important points about his car checked accurately and without cost, and with a minimum of lost time.

Such are the thoughts that have prompted the use of "Safety Lanes" in many cities and large towns. The writer recently spent some time watching the operation of one of these lanes that had been placed in operation by the Save-a-Life Campaign of the Plainfields (New Jersey). The results of the first week of operation of this lane were astonishing. Out of 1984 cars examined for the first time, only 649 passed! Of those rejected, 696 had defective brakes, 798 had improper lights, 304 had no "stop" lights, 130 had defective wheel alignment. Add to these the other troubles with steering wheel play, windshield wipers, horns, and mirrors, and there is presented an impressive picture which might be entitled "Why Accidents Happen."



Above: **A headlight-testing unit in operation.** *Right:* **What operator sees in the machine. Rectangle at left shows pattern made by incorrectly focused lamp; one at right by corrected lamp**



Essentially, a Safety Lane consists of a collection of equipment for testing, accurately and rapidly, the important parts of the car. In the lane mentioned, one side of a street in town was set apart for the work, and here were installed a headlight tester, a wheel-alignment indicator, and a brake-testing machine. When a car was to go through the lane, the driver proceeded to the proper point and registered. Here he was given a card with spaces in which attendants were to indicate the results of the tests. Then he drove under a canopy, and lights were checked. A little farther on, he stopped for an attendant to test horn, windshield wiper, and mirror. Then another attendant determined whether there was the proper play in the steering wheel.

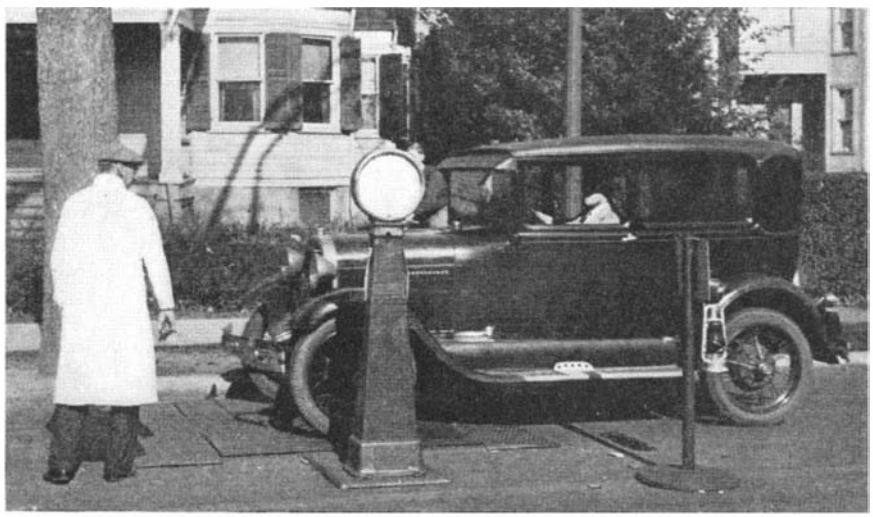
FROM this point, the driver proceeded to drive onto and over two plates set almost flush with the roadway, by means of which wheel alignment was tested and indicated on a large dial. Next in order was the brake tester. The car had only to be driven onto two plates, and the brakes applied. Braking force and brake equalization immediately are indicated by the rise,

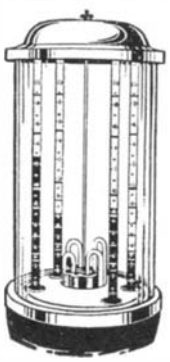
in four glass tubes, of a colored liquid. From the brake-testing machine, the driver went on to the final stop where, if his car has passed all of the tests, he was awarded a windshield sticker that proclaimed the fact. If the car failed, the driver was expected to have the trouble remedied and return for another test. The entire time required was short; the writer went through all of the tests, and the time from registration to the award of the sticker was less than ten minutes.

THE device used to test the focus of headlights consists of a box mounted on a frame in such a manner that it may be conveniently raised or lowered to accommodate various heights of headlamps. In the front of the box are two pairs of slots, 1/8 of an inch wide, which admit light to a mirror within the box, from which the light is reflected onto a ground-glass screen where it is visible to the operator. On the screen are index marks the same distance apart vertically as the slots in the front of the box. If the rays from the headlights are parallel and therefore in focus, the rays visible to the operator will coincide with the index marks on the ground glass. If not, they will be diffused on either side of the index marks.

Proper wheel alignment is a real safety factor because, if the wheels are out of line, difficult steering will result and tires will wear rapidly and unevenly. The increased danger from blowouts due to this latter cause is alone sufficient reason for a check of wheel alignment. The device that tests this factor determines the angle of the contact between the tire tread and the road surface. It consists of two flat horizontal plates mounted on roller bearings so that they are free to move sidewise to a limited extent. The plates are constrained to move apart or toward each other in unison by a linkage that also transmits the motion to a large dial placed on a pedestal beside the plates. If the wheels of a car under test are out of alignment, and therefore have a certain amount of sideslip when the car is in motion, the plates will move as the car rolls upon them, and the exact amount of sideslip in feet per mile will be indicated on the dial.

Below: **A car rolls upon the wheel-alignment indicator. *At left:* Side-slip in feet per mile is registered on dial**





Above: **A brake-testing machine that registers the braking ability of each wheel separately. *Left:* A close-up of the four tubes in which liquid rises to indicate, for each wheel, braking force**

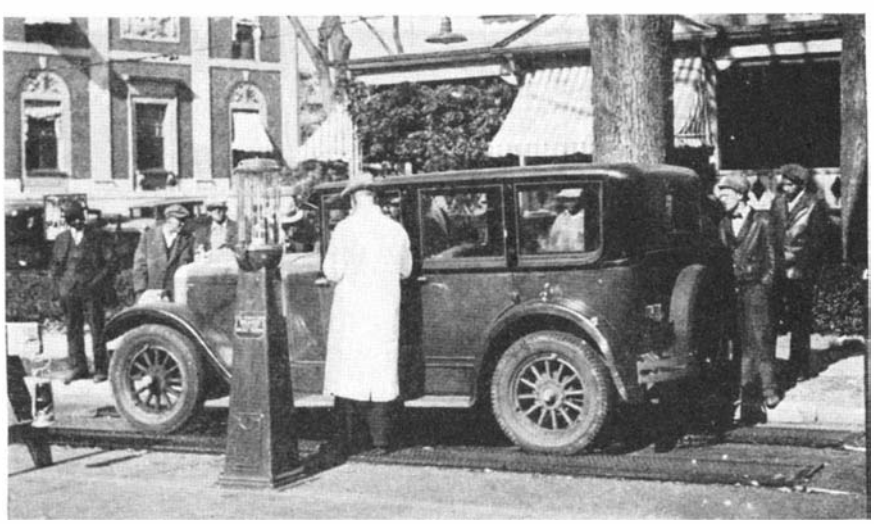
The brake-testing machine consists essentially of four horizontal scales so arranged as to measure simultaneously the braking ability of each of the four wheels of a car. It also gives a direct comparison between the individual brakes and between the front and rear wheels, taking into account the effect of the weight transfer from the rear to the front which is caused by the shift of the center of gravity of the car when a stop is made.

The four plates of the scales are mounted on roller bearings which leave them free to move endwise, the movement being resisted by calibrated coil springs. Thus the amount of movement of the plates is proportional to the force acting endwise upon them. This movement is transmitted through a mechanical linkage to pistons which are located in the pedestal that supports the indicating tubes.

THE movement of the pistons, each controlled by an independently acting plate, forces a colored liquid through valves and up into the glass tubes which are calibrated in pounds. Thus each wheel, as it is braked, indicates the force applied to it, and a direct comparison is immediately available. The liquid stays in the tubes until the car drives off, when a mechanism is tripped which releases it. All of these devices, used in the Plainfield and many other Safety Lanes, are made by the Weaver Manufacturing Company of Springfield, Illinois.

Such campaigns for safety, conducted by communities, instil a spirit of cooperation in motorists, and serve to bring attention to the fact that the motor car is a fallible machine, and must be accorded proper care if its operation is to be as safe as possible. Many communities and large garages have installed Safety Lanes as permanent fixtures, readily accessible to the public at all times, and without cost to drivers.

It has been found that motorists are quick to sense the economic value of such a service. Troubles that are located before they become acute may be remedied at small cost; if not found, large repair bills—and dangerous accidents—may result.



MACHINES THAT THINK

THE article published below describes a purely mechanical device which can think and learn; likewise its startling performance. The construction of this thinking machine is one of several recent attempts made by some of the psychologists to test their suspicion that, when science has finally learned what thought is—if it ever does—it will turn out to be some purely mechanical process, nothing more. Perhaps the majority of scientists incline at present toward this suspicion. It must at once be said in warning, however, that no single "thinking machine" experiment, and no series of such experiments, has yet *proved* what thought is. Any such claim or inference would be premature and out of place at the present time.

The idea that thought is purely a mechanical process is only a *hypothesis*. Experiments with thinking machines are justified because in science it is always worth while to explore fully the possibilities of anything which seems at all suggestive. Those of our readers who do not care about philosophical problems such as the nature of thought will find that the performance of a thinking machine like the one described at least provides good entertainment.

The question—what is thought?—is really a part of a still larger philosophical question which occupies the minds of many scientists today—what is life itself? Is it too something purely mechanical? Are we and the other animals on the earth simply machines—elaborate and very complex it is true, but machines none the less? The behavioristic psychology, which the author mentions, falls in with that interpretation. We believe we choose our conduct, that is, that we have free will, but behaviorism asserts that our immediate environment "chooses" it for us. Whatever we do, no matter how trifling, is the resultant of a whole complex of stimuli received by us from without. Thus our conduct is determined ("determinism").

Science is divided roughly into two camps, the mechanists and the vitalists. The vitalists, who are in the minority, believe that life is not merely mechanical but is something over and above the mechanical processes which we see. This is allied to the familiar belief in a soul or a spirit, and is a kind of scientific mysticism. The mechanists, two parties of whom, the bio-physicists and the bio-chemists, are tunneling into the mountain of our ignorance from opposite sides, with remarkable success thus far, maintain that beliefs like this rest merely on gaps in our present knowledge and that the two tunnels eventually will meet, revealing fully what life is and, with it, probably what thought is. They believe that life and thought will prove to be ordinary phenomena governed by the laws of physics and chemistry, like other common phenomena.

Neither side can prove its case at present and so the reader must patiently wait.—*The Editor.*

By THOMAS ROSS

THE fundamental ideas of the behavioristic and gestalt psychologies justify attempts to construct and develop machines of a new type—machines that can think. Such machines are entirely different from the integraphs, tide calculators, and the like, to which the term "thinking machine" is sometimes applied, for, unlike the latter, they are not designed to perform with mathematical regularity but can "learn" to vary their actions under certain conditions.

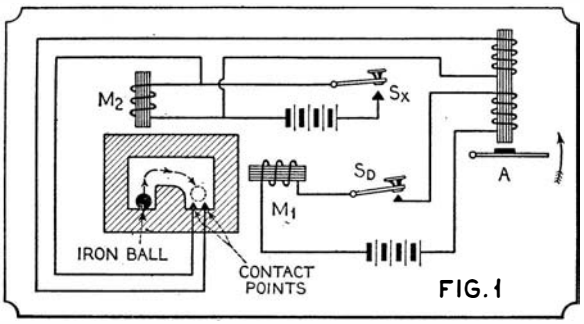
Several mechanisms have been designed and built to illustrate the "conditioned reflex," regarded by behaviorists as the basic element of mental activity. These mechanisms exhibit in simplified form the type of activity studied by the Russian psychologist and physiologist, Pavlov, in his well-known experiments with dogs. This experimenter observed that, while the taste of food normally caused the mouths of the dogs to water, most sounds and sights would not evoke this response; yet that, when one of these "neutral stimuli" was presented before or at the same time that the dogs were allowed to taste the food, the response came to be called forth by it just as by the actual taste. The salivary responses of the dogs had become conditioned to the neutral stimulus. In like manner, stimuli that are originally neutral in the machines are able to acquire power to produce the responses of the originally "dominant" stimuli.

An electrical device which parallels the effect of the conditioned reflex within limits is illustrated in Figure 1. When the switch, S_D (representing a sense organ sensitive to a dominant stimulus), is closed, the metal arm (response lever) A, is moved by the electro-magnet in the circuit with the switch. At the same time, the magnet, M_1, is also energized, but produces no observable effect. Closing the other switch, Sx, only raises the iron ball to the top of the chamber in the "memory cell" before conditioning has taken place, as only the magnet M_2 is energized by closing the switch at this time. However, if both switches are closed simultaneously, the response at the lever A is evoked and the iron ball in the memory cell is also first raised past the obstructing shoulder by M_2 and then drawn over on to the contact points by M_1. Conditioning occurs when this change takes place in the memory cell, for afterward closing Sx causes current to pass through the iron ball and then through the separate coil around the core of the magnet which originally operated the response lever, A, thus producing the same effect as was originally produced by closing S_D.

OF the mechanisms somewhat similar to this which have so far been constructed, some have been equipped with more than one part corresponding to Sx and, of course, such machines could be made with more than one receptor for dominant stimuli and any desired number of responses. (A device of the type which has more than one neutral stimulus receptor and which, though very simple, exhibits reactions which parallel a wide variety of psychological phenomena has been designed and constructed by Robert G. Krueger and Professor Clark L. Hull of Yale University.)

Since it is possible to parallel the conditioned reflex as it is observed in the laboratory, the idea suggests itself that machines embodying this principle can be made to move about and learn from stimuli encountered during their movement, just as animals do. For example, it should be possible to make a machine capable of learning its way through a simple maze. A machine of this sort, together with the type of maze it is designed to be used with, is shown in the photograph, Figure 2.

Figures 4 and 5 show the mechanical features of a machine of the same type, without connecting wires, and Figure 6 shows all of the electric circuits. In these diagrams, all parts having similar functions are marked with the same letter, while numerical subscripts are used to designate individual parts. Each lettered part has a vital function which



An electrical memory cell that demonstrates, within its limits, the basic element of mental activity

will be made clear in the following explanation:

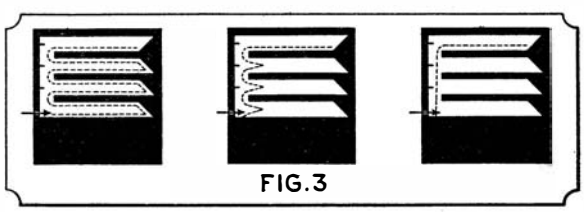
The inset in the lower right hand corner of Figure 4 shows a typical memory cell of the sort used in the maze learner. (Subscripts such as A_1, H_2 and so on, are omitted, as this is a generalized description equally true for all four of the memory cells used in the machine.) Parts A, B, and C are the three points of a single-pole double-throw switch. The movable pole, B, is made of spring brass under a slight tension so as to bear upward against the downward protruding tip of the wire rest, and bears on its free end a piece of soft iron. As will be seen from the drawing, a notch in a pivoted beam can be placed over the wire of the movable pole in such a manner that this pole is held rigidly away from both A and C.

WHEN the machine is operated, there comes a time (different for each cell) when the electromagnet D is energized to act upon an iron disk on the pivoted beam, with the result that the notched end of the beam is raised so as to free the arm B. At the same time, the circuit which includes D, the pivoted beam (the beam is of brass), and the copper jaws X, is broken at X. The freeing of the switch arm B is the "sensitization" of the cell, for, after this operation, B is ready to be drawn aside to either A or C by the action of the magnets H seen in the plan view of the base.

Once contact has been established between either A or C and B, this contact remains unbroken until it is manually disturbed in resetting the machine. The formation of such contact by successive energization of D and H is the process which, in this machine, is equivalent to conditioning.

Obviously, such a memory cell could be operated by hand switches like those used in connection with the cell in Figure 1, but its potentialities are not limited to this. By embodying four such cells in a mechanism which possesses a limited degree of freedom of movement and which is provided with the necessary sources of energy under the control of these cells, it is possible to demonstrate that the resulting mechanism is capable, in a restricted sense, of exhibiting spontaneously intelligent behavior.

The moving member of the machine is an arm, like the boom of a derrick, which carries at its tip the *sensory* switches of the apparatus. Up and down movement is provided for by a pivot in the center of a vertical disk, while horizontal swinging is allowed by a pivot on the axis of a vertical cylinder which bears the disk carrying the arm, as shown in Figure 5. The movements made possible by these two pivots enable the machine to move its sensory tip, when placed as shown in Figure 3, through the slots of a cut-out maze. (Sliding contacts, indicated by the parts marked E and G, serve to carry electricity between parts which move relative to one another.)



Paths of the sensory tip of a "thinking machine"

Henceforward the explanation can be followed to best advantage by re-

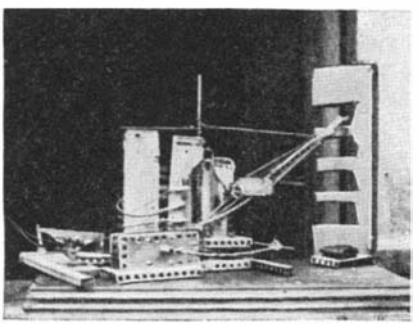
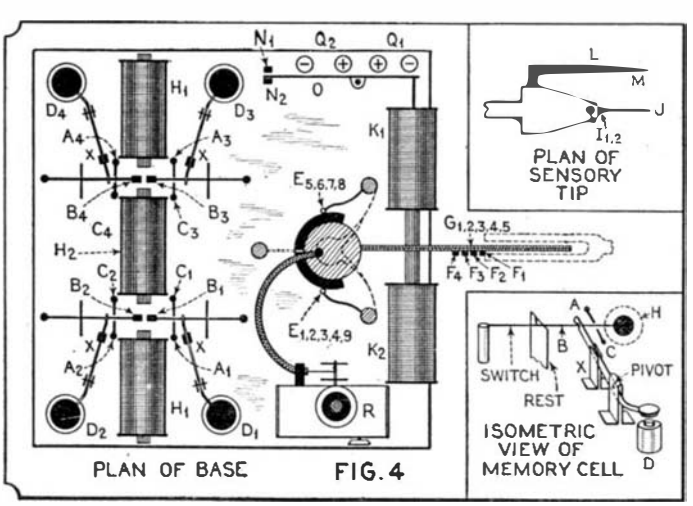


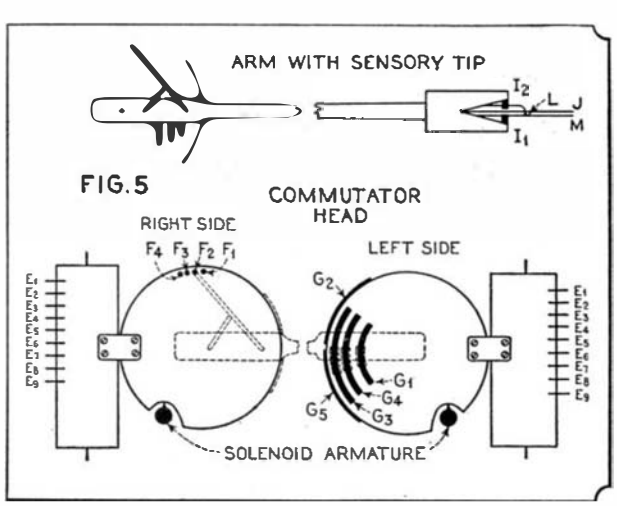
Figure 2: **An experimental model of a machine that "thinks." The four-slot upright maze is at right**

ferring to Figure 6 when circuits are designated and to Figures 4 and 5 when mechanical features or single units are named, for wires have been omitted from Figures 4 and 5 for the sake of clarity and spatial relationships have been disregarded in order to represent the circuits of Figure 6 with the maximum of simplicity. For instance, the switch arms B and the magnets H are shown widely separated in Figure 6 and represented in their true relationship in Figure 4.

The sequence of operations for the machine as a whole follows: The machine is set up with its sensory tip at the point indicated by the arrow in Figure 3. The battery Q_2 is then connected, with polarities as indicated, but nothing then happens because the sliding contact E_6 is so formed that no current can flow while the sensory tip is to the extreme left.

Next, Q_1 is connected, causing current to flow through the circuit Q_1, K_2, N_2, O. Immediately the action of the solenoid K_2 upon the iron armature con-





Details of the various parts of the "memory cells" and actuating mechanisms

nected to the vertical disk, on which the "boom" with the sensory tip is mounted, causes the sensory tip to be moved to the right.

When this motion has begun, E_6 moves into a position to carry current which passes through the circuit Q_2, E_6, G_1, F_1, E_1, D_1, X. Thereupon, sensitization of the cell, including the part B_1, takes place as explained in the paragraph devoted to that function.

At this time, it is to be noted, the first connection X is broken, and, for the time being no more current can flow from Q_2. The motion of the sensory tip to the right, however, continues until the switch tongue J strikes the end of the lowest passage of the maze. The sloping end of the passage causes J to make contact with I_2 and current flows through the circuit Q_2, E_6, G_1, J, I_2, G_3, E_7, H_1, K_1.

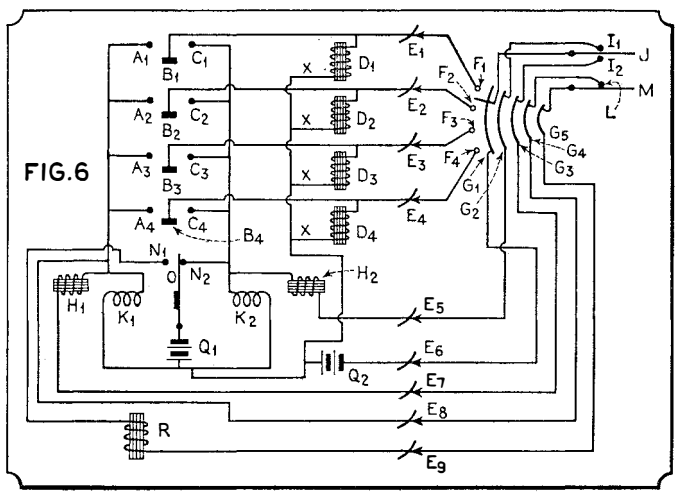


FIG.6

Circuit diagram of the parts of a "thinking machine"

The energization of the conditioner magnet H_1 (this magnet is in reality two magnets connected in series, as shown by Figure 4) causes B_1 and A_1 to be thrown permanently into the circuit just designated, in such a manner as to shunt out the parts I, J, and H for that position which the tip of the sensory arm now occupies and for all other positions in which the switch-point F_1 is connected to G_1 by the brush (which is common to the sliding contact and the line of switch points).

THUS, the machine is conditioned to withdrawal from the lowest passage of the maze. The flow of current through K_1 not only causes withdrawal from the passage, by acting upon the armature on the disk, but also throws the switch O from its contact at N_2 to a new contact at N_1. Thus it not only prevents K_2 from acting against K_1 but also establishes the new circuit Q_1, O, N_1, R, E_9, G_5, M, L, G_4, E_8, K_1.

The electromagnet R thereupon releases a clockwork mechanism, which, through suitable mechanical coupling, acts to raise the arm bearing the sensory tip. The circuit just named is regenerative in such a way that, once established, it will persist even after Q_2 is isolated from its own circuit by E_6. Therefore, the arm continues to be raised until M is caught on one of the pegs protruding from the left hand side of the vertical passage of the maze. This breaks the circuit at L and M, causing R to lose its energy and bringing the arm to a stop in its upward progress. Simultaneously, K_1 releases O from N_1 allowing it to resume contact with N_2.

Now everything is as it was, except that the first memory cell has been conditioned to withdrawal and the machine is ready to "explore" a new passageway with its sensory tip. In the new position the switch-point F_2 is ready to carry current from Q_2 through the second memory cell, and conditioning takes place with a cycle of operations similar to that just described, but involving only the *heretofore unused memory cell.* Finally the machine comes to a stop with its sensory tip bearing against the upward slope of the last passage. Here conditioning takes place which causes it to remain, for in this case H_2 is brought into play, as may be seen from the wiring diagram. Now the path traced by the sensory tip looks like the line shown in the first diagram of Figure 3. We may take the fact that the machine stops with its tip in this position to indicate that the machine "likes" to have the tongue J deflected upward and "dislikes" to have it deflected downward or left in neutral.

When the machine is next placed with its sensory tip in the starting position, it will move so as to trace a path like that shown in the second diagram of Figure 3. Mechanically, the reason for this is that the conditioning of the memory cells furnishes a path through which current can flow to the solenoids K from Q_2 whenever E_6 will allow current to flow. As the points F allow only one memory cell to be connected at a time, the entry or withdrawal response must be appropriate to the passage to which the sensory tip is opposed.

A behaviorist observing the way in which the machine would react on first and second explorations of the maze might say that the beginnings of the entry movements on the second trial served to recall, through kinaesthetic stimuli, the experience of exploring each passage in question on the first trial. In this sense the points F become terminals of kinaesthetic, or muscle-sense receptors.

Further refinement of the mechanism would make possible a machine which would drop out all excursions into blind alleys, as shown in the third diagram of Figure 3 but the significance of such refinements was not considered sufficient to justify the difficulty of construction which would have been added to the most recently constructed model.

Inasmuch as it is possible to design a machine to learn its way through a maze, using only such a simple approximation of the conditioned reflex as is used here, it appears possible that machines exhibiting behavior that may truly be described as intelligent may be realized when the manifestations of conditioning are more closely duplicated. Therefore the author of this article is bending his efforts toward the invention of a small and efficient memory cell to be used in mechanisms for testing the following conception of thought:

Thought is minimized action. A series of events in the environment of an intelligent creature causes the creature to make a series of adjustive movements. At the same time, various events of the series become conditioned as stimuli for succeeding movements of the creature. Each response may become conditioned to any of several preceding stimuli, and also to the simultaneous stimuli produced by the creature's own movements. For these and similar reasons, there is crowding of responses when the series of events in the environment is re-initiated. This means that some responses will be virtually eliminated, others decreased, and still others (particularly the terminal ones) retained practically unweakened. Therefore, less time is required for the creature to recall the approximate response to the terminal event of a series than is required for the terminal event to occur after the initial event.

The awakening of a retained sensory impression when its response is made is memory in the common sense of the word. Thought, then, appears as a means of "trying" different actions and anticipating their results through a process of automatic recall.

The problem of thought being thus analyzable—and elementary learning machines have been successful—it appears that, as Professor Hull remarks, "at a not very remote date the concept of a 'psychic machine' may become by no means a paradox."

●

Do you believe in birth control? In an early number this question will be discussed—without gloves.—Ed.

Grimsel Lake and the two dams which create it; a hospice on the peak between the dams; and a motor road

MELTING GLACIERS SUPPLY ELECTRICITY

IN Switzerland, another important step in the electrification of the country has been accomplished by the construction of a large seasonal storage plant: the Oberhasli Hydroelectric Development above Meiringen in the Bernese Oberland. Construction work on the first step of this huge project was completed recently, and the Handeck generating station placed in regular operation on October 1, 1932.

The development utilizes rain water as well as melting snow and ice water of a total area of 43 square miles, mostly from glaciers. Since the natural flow of water from this area is such that about 95 percent of the total annual flow takes place during the six summer months, it was essential to provide huge storage basins to collect the water during the summer for carrying the high peak of power demand during the winter. It was therefore decided to create two large artificial reservoirs, Grimsel Lake (Grimselsee) and Gelmer Lake (Gelmersee), of a capacity of 3500 million and 450 million cubic feet respectively. The two lakes are interconnected by means of a tunnel, thus forming, in effect, one huge storage basin.

Grimsel Lake has a surface of 27 million square feet and a total length of approximately 3½ miles. It is formed by two dams, the Seeuferegg Dam and the Spitallamm Dam. The Spitallamm Dam is the outstanding feature of the entire development, due to its size. The dimensions of this dam, at present the largest in Europe, are: height above bottom of foundation, 375 feet; height above sea level, 6300 feet; length, 850 feet; amount of concrete, 12,000,000 cubic feet.

THE water of Grimsel Lake passes through the horizontal tunnel to Gelmer Lake and from there through a pressure line to the Handeck generating station. This pressure line consists of steel tubes having a diameter of approximately eight feet, in a tunnel 3700 feet long, which covers a difference in altitude of 1750 feet at a maximum inclination of 72 percent.

The Handeck generating station is equipped with four vertical units, each a Pelton type turbine of 30,000 horsepower and a generator of 28,000-kva capacity operating at a speed of 500 revolutions per minute and delivering power at 11,000 volts.

Because of the large number of avalanches coming down in the neighborhood of the generating station regularly every winter, it was not considered safe to use high-tension overhead lines. It was finally decided, therefore, that a reliable supply could only be obtained by means of underground cables. Thus a special cable tunnel 3.1 miles long has been built, connecting the generating station with the village of Guttannen. The power is stepped up at the generating station from 11,000 volts to 50,000 volts. It is transmitted over four 50,000-volt tunnel cable circuits to Guttannen and from there over four 50,000-volt overhead lines to the Innertkirchen transformer station. The cable tunnel has been built large enough to permit the passage of a small electric car which is the only means of communication between the generating station and the villages in the lower part of the valley during the winter season.

At the Innertkirchen transformer station the power is stepped up to 150,000 volts and transmitted to the consumers in the central part of Switzerland.

Later, it is planned to conduct the water from the turbine outlets of the Handeck station to another generating station which will be built near Innertkirchen. This will increase the annual production of the development from the present 230 million kilowatt-hours to approximately 540 million kilowatt-hours.

The exterior of the barns and milking parlor where an effort is being made to attain ideal milk

The Most Perfect Milk Possible

By O. ERF

Professor in Charge of Official Testing of Dairy Cattle,
The Ohio State University, Columbus

EVERYONE knows the value of good milk. Milk is a result of Nature's reproductive process. But, to commercialize the only complete food in its natural form for the young presents many difficult problems.

To overcome some of the complex difficulties Wm. R. Kenan, Jr., has built a plant in which the milk is taken from the cow directly into the bottle, thereby retaining a very large percentage of the nutritional factors, which are largely lost with present practices.

The milk is drawn directly into nitrogen gas-filled jars which are partially vacuumized, and delivered into milk bottles which are also partially vacuumized, and then is immediately capped. Next, cooling takes place with heavy air blasts by specially constructed refrigerating equipment. The prime object is to preserve the udder gases and to prevent oxidation of some of the nutritives by air.

The milk must be produced from healthy animals which have been tested by an approved veterinarian for such infections as tuberculosis, undulant fever, mastitis, and so on. Every sanitary precaution within the range of economical production has been taken to produce the most perfect milk possible.

The inception of this work was brought about by a group of pediatricians who had encountered some nutritional difficulties from the milk they were using. This milk was of average quality, produced under reasonably sanitary conditions, and pasteurized.

These difficulties led to a long series of feed investigational problems in which it was discovered that the mineral and vitamin content of the cows' feed had been more or less ignored in the past. The results indicated that high-producing cows fed on ordinary feed made milk with a low nutritional value. Hays and grains properly grown on good soil proved to be valued factors for increasing nutrition in milk. Proteins, carbohydrates, and fats in relation to crude fiber and water had been the principal factors taken into consideration in feeding cows. Now, however, hays are selected which have been fertilized with the necessary mineral constituents and a feed is produced not only rich in proteins, carbohydrates, and fats but also well supplied with minerals and vitamins.

THIS part of the ration can easily be supplied in the best possible form to cows on selected fertilized pastures which are frequently mowed to maintain a high vitamin content. We have found that the short average common variety of pasture grasses contain more vitamins and minerals ordinarily than these same grasses grown tall and matured. However, during the greater portion of the year, especially the winter months, it was not possible to supply this nutrition.

It was then discovered that many vitamins, particularly vitamin A, and other nutrients, could be largely preserved by dehydrating such grasses; and that the sprouting of grains increases the vitamin content of the feed and also increases and furnishes additional enzymes for digestion. Then, by subjecting the cow to ultra-violet rays, so that the udder, eye and nose, as well as the inner part of the ear, could absorb the direct and reflected light, there was an essential increase in vitamin D, the bone-forming part of milk.

However, after all of these valuable additions to the milk had been provided, it still was found that calves nursing on the cows presented examples of more complete nutrition than calves fed from the bucket. This held true even though the cows received the same feed and, as nearly as could be determined, produced similar milk. It indicated clearly that nutritional factors were lost after milking which could possibly be retained.

Consequently a series of tests was instituted to determine the factor that made the difference. At first it was thought that the bacterial content of the milk might have some influence; then the gulping of the calf was considered.

None of these and many other minor factors as far as could be determined were of value.

WE found accidentally, by milking through a special machine which excluded the air, that the difference in nutrition was then noticeable. When this milk with its retained heat was fed immediately there was practically no difference. This led us to determine the amount of gas coming from the cow's udder. Under average conditions this ranged from 6 to 9 percent. Upon chemical analysis this gas proved to be complex in character, consisting mainly of carbon dioxide and volatile oils which apparently were partly synthesized butter fats. The carbon dioxide was found to hold vitamin C in apparent combination with milk; it also acts as an acid buffer to the alkaline salts, which helps casein digestion in children. The gas held the calcium, which is beneficial in a semi-liquid form. Dr. Evelyn Sprawson's dental report to the Royal Society of Medicine, March 1932, Vol. XXV, clearly indicates the value of calcium in a natural organic form for children. This kind of milk fed during the first four years of life seems to be a preventive for dental caries which occur later. It is common knowledge that, often during pregnancy and nursing, a mother's teeth become defective. This is only an outward indication of what happens to her whole bony structure, due to the fact that her diet has not provided her with the vitamins and minerals sufficient to maintain her own system and furnish the rapidly developing child.

To prove the practicability of our discoveries it became necessary to build machines which would hold these gases more or less in suspension in the milk.

These machines, as well as other equipment necessary to accomplish the nutritional results, were finally established in a so-called Dairy Inn. Easy and effective methods for cleaning and sterilizing the machines were used.

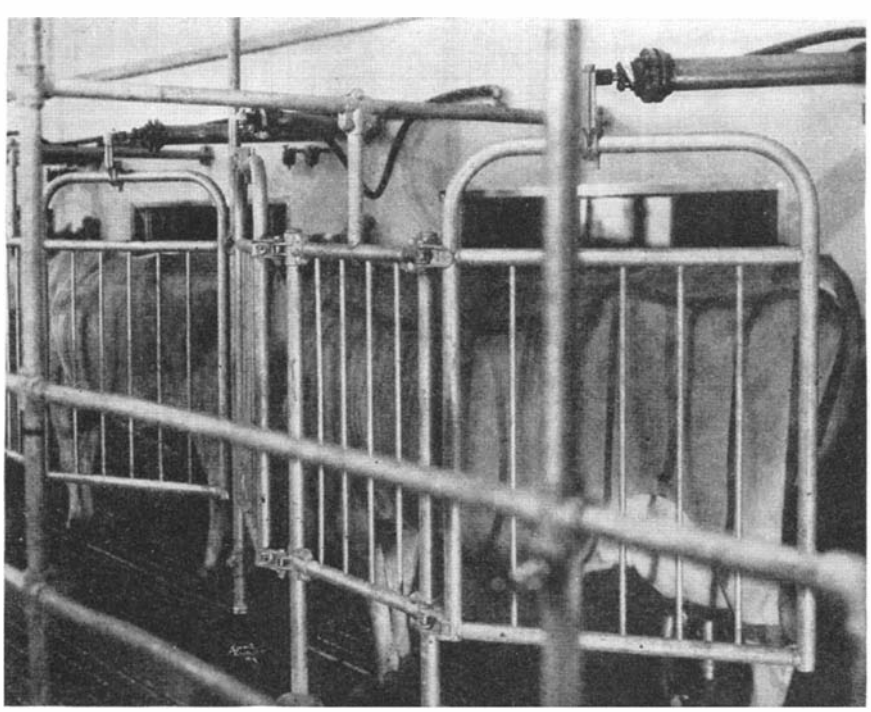
The cows are kept in an adjoining building where they are fed the high vitamin and mineral feeds and where they are housed mostly in individual box stalls which are deeply bedded with dry straw. The stalls are well ventilated and the litter is removed daily. In such a well-housed, pure bred herd—where cows from other herds are rarely introduced—the chances for infection are small. This is especially true because the teats are treated before milking with a newly developed spray which consists of very dilute collodin with antiseptic properties that does not injure the teat, and protects the end from infections, but specifically prevents outside infection from being introduced into the milk. The cows, after being cleaned, walk up the ramp into the milking stalls opposite the observation room. The walks in the ramp are made of wire grating. This permits sluicing the waste matter with waste water from the ice machine into a septic tank. From there it flows through tile under the pasture for irrigation and fertilization.

The ultra-violet ray lamps along the walk ray the cows, which are detained for a short interval in front of the lamps. The gates on the milker stalls are operated with compressed air by the milker from the milking room. The gates are arranged so that the cows can enter only empty stalls. The gates force the cow in so that the udder is in front of the milker opening. The teats having been sprayed, the teat cups are attached, the milker is vacuumized to 15 inches and, with the action of the electric pulsator, milking begins. The milk flows into a Pyrex receiver which was filled with nitrogen gas to displace the air not removed by vacuum. After the cow is milked the teat cups are removed and placed in the sterilizer. Here they are cleaned and made sterile while the cows in the milking stalls are changed.

Milk from the milking machines is delivered to vacuumized receivers

THE milk in the receiver is released with nitrogen gas and flows to the bottler receivers, where the milk from the herds is mixed and bottled by a vacuum bottler. The quart bottles are previously cleaned, chlorinated, placed in a hot-air sterilizer at a temperature of 230 degrees, Fahrenheit, for several hours, after which they are subjected to sterilizing light before they are filled. The bottles are at a temperature of 95 degrees, Fahrenheit, as they come from the bottler. They are now placed in crates and immediately cooled to 42 degrees, Fahrenheit. This cooling is done by a fan and a refrigerating coil so constructed with ducts that air passes around the bottles at a high velocity. The temperature of the milk is thermostatically controlled, so it can not freeze. On cooling, the milk gases are held in suspension in the milk; it can be poured from the milk bottle without losing much of the gas and into drinking glasses or nursing bottles which should be stopped with the nipple before warming.

While we do not contend that we can save all of the nutrients in the milk we are, however, approaching nearer to the ideal milk supply, especially for children.



Air gates which regulate the incoming and outgoing of the cows. Each gate is operated by means of compressed air and a piston which is seen at the top

BUILDING MODEL STARS

With a Glimpse at a Laborious Indoor Sport of the Mathematician-Astronomer

By HENRY NORRIS RUSSELL, Ph. D.
Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

THE love of making models is a normal human trait. Sometimes the motive is purely one of representation, as when a sailor with infinite pains builds up his mimic ship inside a glass bottle. Again there is a serious practical purpose, like that of the model ship's hull made exactly to scale, for testing in an experimental tank, or the miniature airplane for testing in a wind tunnel. Both of these types of model have their place in astronomy, the one for teaching, the other for investigation; but in both cases there are special difficulties to be overcome.

With the first or museum type of model the great trouble comes from the enormous range of astronomical distances. Their mere magnitude makes no trouble except to label the scale of miles or light-years properly. But it is quite impracticable to make an honest scale model of the solar system. The orbits are bad enough if we put Mercury an inch from the sun; Pluto at its farthest then has to be more than ten feet away. But, on the same scale, the sun would be represented by a tiny pellet only 1/40 of an inch in diameter; Jupiter by a dust speck 1/400 of an inch across, and the earth by a microscopic particle less than 1/4000 of an inch broad. The traditional orreries which purport to represent the positions and motions of the planets are grotesquely, nay absurdly, out of proportion, showing the planets thousands of times too big, so that it may be gravely doubted whether they convey more of truth or of error to the uninformed spectator.

THE satellite systems of the planets suffer from the same difficulty, though the scale models of the earth and moon and of Jupiter and his four large satellites are practicable, and would be very instructive. However, the writer cannot remember ever having seen either one on exhibition.

Something might be done for the stars. A model in three dimensions, showing on a proper scale (say, a few inches to a light-year) the true position of the stars nearest the sun would be interesting, particularly if it were set up in a darkened room with the stars represented by tiny lights, being in space in their proper positions and adjusted so as to be of the true relative brightness and color.

Variable stars, too, offer opportunities—perhaps the best of any. There is no reason at all why eclipsing variables should not be illustrated by true scale models correct in shape, size, relative brightness and color, in which two opal glass spheres illuminated from within revolved at appropriate distances from the common center of their orbits and could be seen to eclipse one another.

THE Cepheid variables, with their regular pulsation, are within the power of the model maker. A spherical rubber balloon illuminated by a light at the center, and of such texture that, seen from a distance, it would look like a self-luminous sphere, might be periodically inflated and deflated while the current through the central lamp was varied. The mechanical devices necessary to keep the center of the sphere fixed in position and to make the expansion more rapid than the contraction, and the electrical connections which would make the light always at the proper brightness, should be of just the sort to tempt an ingenious amateur or professional mechanic. One important point, the change in color of the star, would automatically result from the changes in temperature with varying current.

A case with half a dozen such models, adjusted in size, brightness, color and period, to represent the actual period-luminosity law and the related characteristics of the stars, would be instructive to a degree, and it might safely be guaranteed that any professional astronomers who were present would be hard to get out of sight of it. Yet nothing of the kind exists anywhere, so far as the writer's knowledge goes.

If anyone, whether museum expert or amateur, should seriously consider the construction of model stars of this sort the writer would be only too glad to discuss details of size, brightness, and the like.

One astronomical model, of course, has been developed on a grand scale and with complete success. The representation of the whole vault of heaven on the dome of a planetarium leaves practically nothing to be desired, and its educational value is very high.

The "model" stars which astrophysicists use in their own investigations are very different. There can be no thought at all of a material model in this case. We cannot get a sample of stellar material under stellar conditions. We might approximate the correct chemical composition, but pressures of billions of atmospheres and temperatures of billions of degrees are and must always remain beyond our power to imitate. And in this case it is of no avail to simulate what actually occurs by the use of other materials, as melted iron might be simulated by melted wax in a museum model of a blast furnace. Essentially important processes, such as the ionization of atoms, cannot be imitated at all at low temperatures and, worst of all, we know no force which can be "turned on" and applied to a small body which will behave at all as gravitation does in a huge mass.

IN this latter case our models, then, must be imaginary—purely mathematical abstractions. In some ways this is a great advantage. Paper and pencils are cheap, so are tables of logarithms, and even calculating machines are not excessively costly, so that the materials for this kind of "model making" are available at all the world's universities and colleges and to any qualified investigator. But, just because these models are immaterial, they are not fool-proof. Actual substances have a wholesome objection to performing the impossible, and we are familiar enough with their properties by common experience to have a fairly good idea what we can get away with if we try to use them. But a purely mathematical process, such as the solution of an equation, for example, operates blindly. It may be that we have started with assumptions that are mutually inconsistent or that lead to physically absurd results. Nevertheless our mathematical mill will keep on grinding, and it is often not until a great amount of labor has been spent in turning its crank that we come to realize that we have made a false start.

Errors in the arithmetic represent a different level of human frailty. Various methods are available for checking up on these and, with reasonable care, they can be detected and corrected. But it is

not so easy to start building our model out of the right stuff.

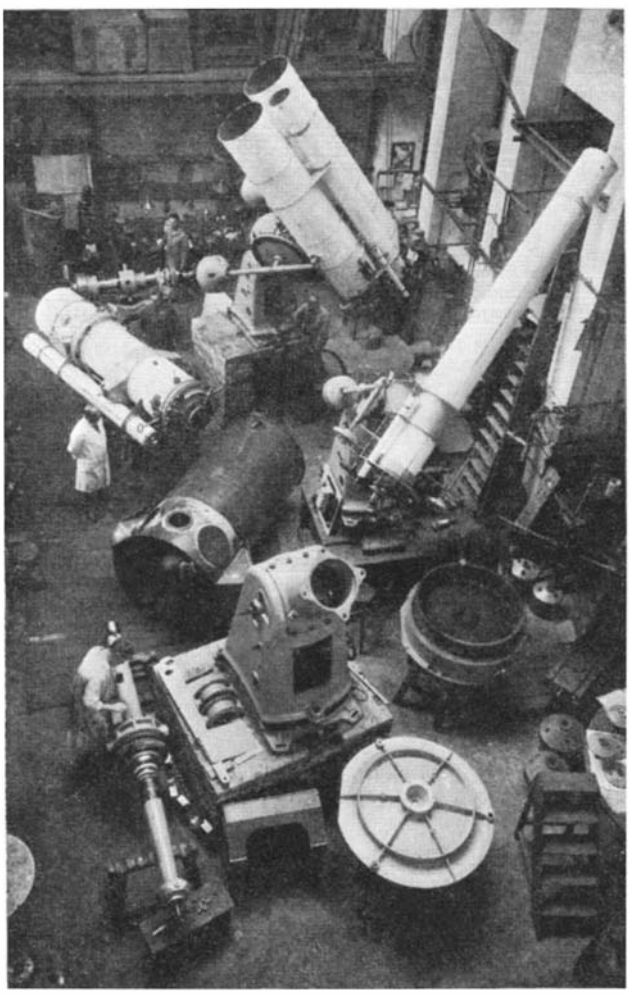
We know in general that the stars are composed of atoms of the kinds which are already familiar to science, and we have a good idea of the relative abundance of the various elements at the surfaces of the stars. But is the composition of the deep interior the same? There is good reason to believe that there are slowly moving currents deep down in the gaseous mass which stir it up, but whether the mixing is complete from center to surface no one knows. It is possible, indeed, that deep inside the stars there may be atoms heavier than any known on earth, though in view of present knowledge this does not seem probable.

THE model maker, faced with this ignorance, usually cuts the knot by assuming that the composition is the same throughout. He is quite justified in this; it is necessary to explore the possibilities of the relatively simple models of uniform composition before attacking the far more difficult problem of variable compositions.

Now, he must answer three questions about his uniform material. How does its density change with the pressure and temperature? How much heat will flow through it under given conditions from a hotter to a colder point? How much heat will be produced within it under the same conditions to countervail the loss?

The first of these questions can be satisfactorily answered. Except at enormous densities the familiar gas laws known to every high school student of science are safely applicable. All we need to know for a complete specification is the proportion of hydrogen in the mixture and, fortunately, there is strong evidence that this amounts to about one third of the whole by weight. So here the mathematical artisan has no trouble. The law governing the opacity of the gas to the flowing radiation, which carries practically all of the heat, is tolerably well known, but we are still in deep ignorance of the very nature of the way in which heat is generated inside the stars—as it must be to keep them shining through the ages.

Lacking information on this essential point the calculator must make a guess, testing his results afterward by their agreement or disagreement with the facts. The simplest assumptions—or rather those which lead to the least laborious calculations—have naturally been the first to be explored and they have led to very valuable results. For example, the assumption that the same amount of heat is liberated from every ton of material, whether in the hot central regions or near the surface, led Eddington to the discovery of the remarkable relation between the mass and brightness of a star, which has been fairly confirmed by later observations. Further theoretical studies have shown that this relation results from the general properties of the gas, and reappears in substantially the same form with very different models; for example, if it is assumed that practically all of the heat is produced in the very small region at the star's center.



Activities in the Carl Zeiss Works, at Jena, Germany. The telescope at the right is a ten-inch refractor for the Astronomical Section of the great Franklin Institute Museum now nearing its completion at Philadelphia. The same Section, under the direction of the astronomer James Stokley, will have for public use a 24-inch reflecting telescope recently completed by J. W. Fecker of Pittsburgh, a spectrohelioscope, a battery of small telescopes to be used on the museum roof, a sun telescope of 85-foot focal length, and the Fels Planetarium, also made by the Zeiss firm in Germany. The museum and planetarium will be open before 1934. There will also be a hall for amateur telescope makers' use

Each investigator has his own pet assumptions and this is fortunate, for, among the half dozen or so now active, we may hope for a good reconnaissance of the possibilities. No one who is not eager for masses of computation should enter this field, for the calculations are laborious in the extreme.

THE computer, having settled in detail upon the laws of heat production and so on, whose consequences he desires to study, starts by guessing at the pressure and temperature at the center of a star. Step by step, with a deal of calculation each time, he works out how these quantities fall off at increasing distances from the center. If at last the pressure falls to zero, and the temperature to a few thousand degrees instead of the millions he started with, he has come to the outside of the star.

But usually the calculated value of one vanishes, while the other does not. This means that he has made a wrong start, and that no star of the given sort of material can exist and have a specified central temperature *and* central pressure. Then he starts again, say with the same central temperature and a new guess at the pressure. It may take a long series of laborious attempts before the correct values are found and he can contemplate a diagram showing the internal constitution of his first model star. Then he must adopt a new central temperature and do the whole thing over again!

The models which have so far been computed are curiously different. Some have central cores so dense that the ordinary gas laws fail and other equations must be used. Others are less dense at the center than half way to the surface, because the pressure of the outflowing radiation actually drives the gas outward. Some are of enormous size—as big almost as nebulae. Others are tiny—no larger than some of the planets. Every one represents an addition to our knowledge and, when the devoted labor of the computers has given us a large enough choice among them, we may hope to know more than we do now about the actual, as well as the possible, constitution of the stars.

WHAT IS 'TELEPATHY'?

SCIENTIFIC AMERICAN'S initial mass test of telepathy, published last month, has aroused a great deal of interest all over the world and completed test papers are beginning to come in. It will be some time, of course, before we have in hand a sufficient number of them to begin our work of analyzing and correlating them. As soon as possible, we will publish full results of the test.

In the meantime, while we await the returns and before we present to our readers another test in which they can cooperate, it is well to clarify the issue at hand. The term "telepathy" has been used loosely by the average person and the still unproved phenomenon has been "accepted" by many on the evidence of personal experience. The purpose of the accompanying article is, therefore, to clear away the misconceptions, and to show just why scientists are not as yet fully satisfied and how it is they propose to get scientific results.— ***The Editor.***

SIGMUND FREUD, the eminent Austrian psychologist who is known throughout the world as the originator of the Freudian theories of psychology which have stirred up more argument in recent years than any other set of theories on mental processes, is the latest scientist to become convinced that there "must be something to telepathy." In a very recent book, he says that there has been and is now being accumulated such a mass of evidence favoring the existence of telepathy that very soon science must recognize it as a demonstrated fact and make an intensive study of its possibilities. To date, scientists have as a rule been open-minded about the subject but studies of it, performed on a scientific basis, have not been very numerous. Scientists have been willing to be shown but only a few research men have attempted to do the showing.

The history of telepathy for the past 50 years or more has been such that in the minds of many the word has been invested with an air of charlatanry. For every serious and exact study—exact in the sense that it has been carried out by scientific methods—that has been published, several that, by inference or by a more direct connection in the titles, have coupled telepathy with stage tricks of all kinds or with spiritualism, may be found in almost any large library. Others have connected it with theatrical mind reading which, as everyone knows, is pure hokum. Seriously, then, just what is to be understood when we speak of telepathy?

THE word is made up from two Greek words: τῆλε, meaning "far"; and παθεῖν, meaning "to experience." The coined word was introduced in 1882 by F. W. H. Myers to denote "the ability of one mind to impress or be impressed by another mind otherwise than through the recognized channels of sense." Expressed in another way, it means "the communication of impressions of any kind from one mind to another, independent of the recognized channels of sense." If the supposed phenomenon were to correspond literally with the term, as it has at times in the past, telepathy would mean a transference of communications between minds at a distance only. In English, however, it has come to mean thought transference, mental suggestion, "mind reading," and the like, regardless of distance. It specifically connotes the exclusion of the ordinary channels of communication, at a distance or within the same room, such as speech, writing, or gestures, or other methods that might be adopted, such as muscular contraction, facial expression, or any other physical and consequently explainable means of disseminating ideas.

Telepathic communications—or what, since telepathy has not as yet been fully accepted as a fact by many, may pass for such communications—may be the result of intention on the part of two or more persons. Usually, however, there are only two—the agent and the percipient, as was explained in our initial telepathy test in last month's SCIENTIFIC AMERICAN—and sometimes the percipient may be unconscious of his rôle, may have no idea that an agent is "sending" him a message.

Older definitions of telepathy say that the agent, in cases of intentional alleged telepathic communications, concentrates intently on an idea that he wishes to transmit to the percipient, but lately there has been some question of the advisability of such concentrating. It is a question whether the mental strain of attempting to hold the thought so rigidly to one idea, object, or message nullifies the effect by the alertness it creates in the mind of the agent and the consequent rapid flow of irrelevant ideas. This question also comes up in cases where the percipient is fully aware of his rôle and intentionally attempts to "receive." It is now believed that it is best for the percipient to relax, compose his mind, and attempt to free his thoughts of any tenseness; as Mrs. Upton Sinclair explains it in discussing the telepathic experiments which she and her husband carried out and which were briefly discussed in our March, 1932, issue, "the percipient should make his mind a blank."

This question of concentration is one of the greatest problems with which serious scientific investigators have to deal. Since so little of a scientific nature has been learned of telepathy, or of all mental processes for that matter, research has to be carried on more or less in the dark in the hope that, by a process of elimination, some method will be found to point the way to more exact and promising studies. Professor G. H. Estabrooks, in a long series of tests with playing cards and a number of students to "guess" suits, colors, and values turned up by cutting the deck, obtained better results when the students did not even know they were participating in a telepathic test. These students were told that it was desired only to make a mathematical check, and therefore they did not concentrate, in the telepathic sense at least.

"INTENTIONAL" telepathy has been tried with more than average success on hypnotized subjects who have been made to imagine tastes, sounds, emotions by mental suggestion. The scientist, however, is more concerned with the results that may be obtained with normal, fully conscious people, and in order to prove or disprove telepathy, it is believed that the scientific approach to the problem must be in this direction. The principal thing to be sure of in any case is that the correct reception of the transmitted message can not be accounted for by similar habits of the agent and the percipient, association of ideas, or suggestions of agreement or perception.

Besides intentional telepathic experiments there is also an apparent form that might be termed spontaneous. In this, the agent has no conscious intention of delivering any message or idea. Nevertheless, many people claim to be percipients; that is, they claim that they

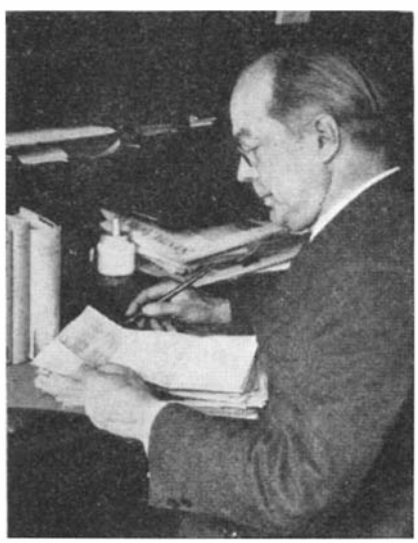
receive messages or sudden flashes of information concerning something that is happening to some absent person. The messages (so-called) most often pertain to sickness, pain, or serious distress of —more often than otherwise—close friends, relatives, or persons for whom the "percipient" has a strong emotional feeling of one sort or another. The very real difficulty in such cases is to determine whether the results are actual rather than imaginary; and, if so, whether they represent mere subjective coincidences, memory, expectation, or real causality.

Some years ago the late Luther Burbank, the plant wizard, told of a case that seems to be incontrovertible evidence for spontaneous telepathy. Burbank said that when he was a youth, his family lived on a farm in a section so sparsely settled that the nearest neighbor was some eight or ten miles away. This neighbor's name we have forgotten, but we'll say that it was Smith. Burbank said that one morning at the breakfast table, his mother suddenly surprised the family by the startling statement that "Mr. Smith is dead!" Not one of the family had even heard that Mr. Smith had been sick, so the entire group at the breakfast table eagerly asked Mrs. Burbank whether he had been sick, how she knew he was dead, when had he died, and so forth. To all of these questions, according to Burbank, his mother said: "I don't know. I know only that he is dead." Asked how she knew and whether she hadn't simply dreamed it, she said she had not dreamed it, but she knew that she was not mistaken. The family was puzzled but soon passed it off as some sort of dream. About an hour later, however, a horseman came over the hill with the news that Mr. Smith had died suddenly during the previous night!

WE say that this seems incontrovertible proof of spontaneous telepathy, particularly since Luther Burbank was in all respects so far as we know a very sane, level-headed man. But we say *seems*. So little is yet known of mental processes and of the peculiar quirks of the mind which may be conducive to some sort of mass hypnotism, that even in this case it can not unconditionally be called telepathy. Some day such occurrences may be explained by a scientific formula.

In the lives of the vast majority of people everywhere, incidents similar to the one just discussed have happened or seem to have happened. They may be true telepathy or they may not be. As evidence for telepathy, however, they can not be accepted at face value, but must be evaluated in relation to the time, the environment, physical and mental condition of both the supposed agent and the supposed percipient, the intelligence of both, and a large number of as yet unknown factors.

It will not do to grant that it is telepathy because one's wife almost invariably mentions a certain thing to be done at the very moment when you, in the next room, are on the point of doing it. We can not say because a friend whom we have not seen for months walks in our door a half hour after we spoke of him, that this is telepathy. Even in the surprisingly apparent results we obtain from "parlor-trick" telepathy, we must refuse to acknowledge telepathic ability, even though to all appearances all chance of fraud is eliminated. Such results may or may not be attributable to telepathy, but for the scientist they can mean but little. Scientific method must be applied before there can be evidence acceptable to science.



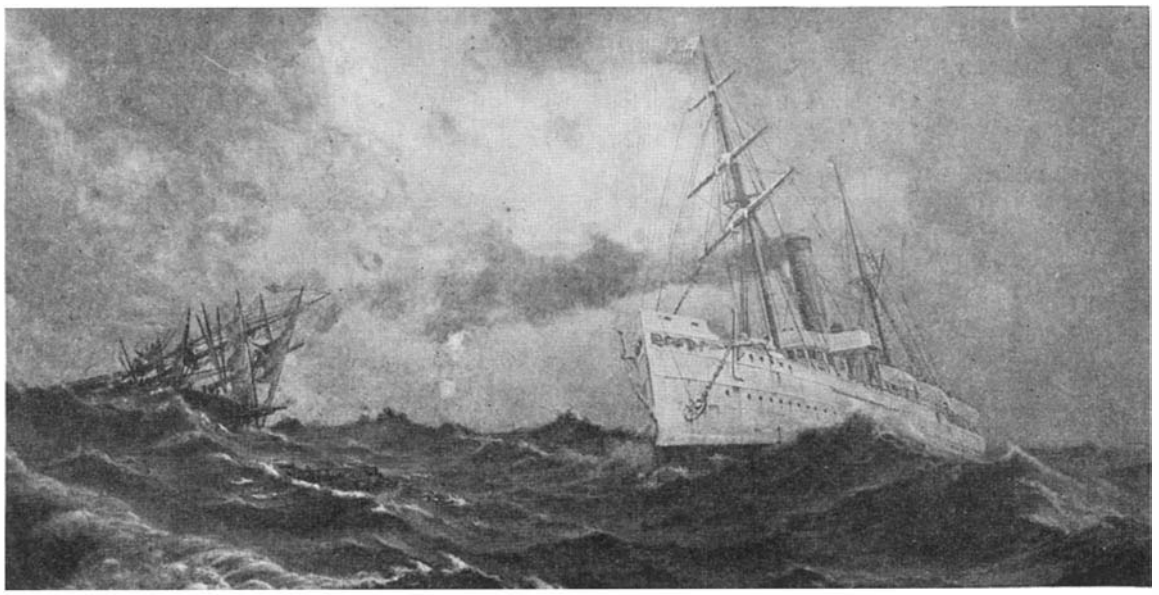
Dr. Walter Franklin Prince who made a masterly survey of the results of the Sinclair experiments in telepathy, and who is co-operating with *Scientific American* in the telepathy investigation announced in our last month's issue

In the application of scientific method, as we have said, the scientist still has to work in the dark. He is concerned with proving the existence of telepathy as a fact, and if that is once proved, to find the explanation of it. Following this, he is confronted with the question of how the faculty may be controlled and developed for the individual uses of human beings. From this it may be seen that haphazard, hit-or-miss, or spontaneous methods of investigation or recording results will not suffice. The problems must be studied in a critical manner, as has been done by so few investigators in the past.

As Dr. Prince showed in his article last year on the Sinclair experiments, Upton Sinclair and Mrs. Sinclair, through a long series of tests evolved just such a critical method. Though neither of the two is a scientist, Upton Sinclair, in describing the tests in a book, analyzed and evaluated them in a fashion that would be worthy of a true scientist. These tests were first carried on between Mrs. Sinclair, as the percipient, and a brother and a friend, each at different times the agent, 30 miles away, and most remarkable results, attested by witnesses, were obtained. Following this series, Mr. Sinclair was himself the agent in a room adjoining that in which the percipient lay relaxed on a couch, and a great number of excellent results, in the form of drawings, were obtained. As you may remember, Dr. Prince, in his article, concluded: "After years of solving human riddles—cases of conscious and unconscious deception, delusion, and illusion—and with due regard for my reputation for caution and perspicuity, I here register my conviction that Mrs. Sinclair has demonstrated the phenomenon known as telepathy."

IN view of this statement, it will be of interest to learn the secret of Mrs. Sinclair's method. She says that the percipient must relax, let go of every tense muscle, every tense spot, in the body. "It may help you," she says, "to start as follows: Relax the body as completely as possible. Then visualize a rose, or a violet—some pleasant, familiar thing which does not arouse emotional memory-trains. Gaze steadily, peacefully, at the chosen object—think only of it—try not to let any memories it may arouse enter your mind. Keep attention steady, just seeing the color, or the shape of the flower and nothing else. Do not think things about the flower. Just look at it. Select one thing about it to concentrate on, such as its shape, or its color, or the two combined in a visual image: 'pink and round.'" Having, by this method evolved by herself, put herself in a receptive mood, she drew the things that came to her mind presumably from the mind of Mr. Sinclair as he concentrated on simple drawings he had made.

If telepathy is a fact, then how is it to be explained? Is it psychological or physical and physiological, of the mind alone or of the body and its nervous system? Various attempts to explain it have supposed the existence of a subconscious mind with powers superior to those of the conscious mind, the existence of some sort of neurotic fluids, brain vibrations, or some special form of energy as yet unknown. Any of these may be as good as any other guess. Science just now wants to know definitely; guesses can never solve the problems of telepathy but they do furnish some sort of foundation on which to build. And science is determined to build, if it is humanly possible, by sounding every depth of the subject.



The cutter *Manning*, of the United States Coast Guard, effecting a rescue at sea. (From a painting)

WATCHMEN OF OUR COAST LINE

By CAPTAIN RANDOLPH RIDGELY, Jr.
United States Coast Guard

IT is deemed a conservative statement to say that about one person in 10,000 knows any real facts in regard to the Coast Guard, outside of those who go down to the sea in ships or those who live close to the coast line of the United States.

When asked to talk about the Coast Guard, it used to be my pet method of introducing the subject to tell the story of a tenderfoot arriving in Texas. The tenderfoot asked the old-timer: "I reckon a fellow needs a gun all the time in Texas?" The reply was: "No, stranger, he don't need it all the time, but when he does, he needs it like Hell!" People following the sea or traveling thereon for business are not always in peril, but when they are, the peril is often grave and it is generally the Coast Guard that assists them.

The Coast Guard was established by an Act of Congress approved by President George Washington on August 4, 1790, and was known then as the Revenue Marine and later as the Revenue Cutter Service. In 1848, the Life Saving Service was established by an Act of Congress to save life and property in danger along the coast of the United States. In January, 1915, the two services were consolidated and now constitute the United States Coast Guard.

The duties of the Coast Guard as specifically prescribed by Acts of Congress or regulations having the force of such Acts are 15 in number but, due to the peculiar nature of the Service and its flexibility and organization, it performs innumerable duties not specified nor contemplated.

It is not necessary to enumerate the duties prescribed by law for the Coast Guard, but the four principal ones in order of importance will be mentioned. They are: (1) Saving life and property at sea; (2) Operating as part of the Navy in time of war, or at such time as the President may direct; (3) Maintaining the International Ice Patrol of the transatlantic steamship lanes; and (4) Protection of the Customs Revenue.

PROBABLY seamen are the most conservative of all professional men, as illustrated by the long fight before steam supplanted sail. The officers and men of the United States Coast Guard are typical seamen, but are not of the conservative type due to the fact that their duties call for the best equipment obtainable both as to quality and efficiency. Therefore this Service has been quick to test out new ideas and readily adopt them when proved efficient.

Considering first the saving of life and property at sea: The weather conditions along the coast line of the United States that are most dangerous for shipping are found during the months of December, January, February, and March. The Revised Statutes of the United States have taken cognizance of this fact and each year the President issues an order designating certain Coast Guard cutters to cruise along the coast in the season of severe weather to afford such aid to distressed navigators as their circumstances require.

Figures are dull and uninteresting, so these will be brief. In the last decade the Coast Guard has assisted and saved vessels and cargoes the total value of which amounted to 416,000,000 dollars; actually saved from drowning 29,000 lives (that *means* saved); and, in addition, there were 200,000 people on the vessels assisted. In cold figures, the Coast Guard, each year of this period, has averaged 41,600,000 dollars' worth of vessels and cargo saved or assisted, the passengers and crews of which numbered 20,000 persons. But above all, the Coast Guard has taken from the water an average of 2933 persons yearly who would have drowned but for the efforts of Coast Guard personnel. From an economic viewpoint, the value of these lives can hardly be estimated.

The Coast Guard has taken an active part in all wars in which this country has been involved since 1790, with the single exception of the war with Tripoli, and has added to the splendid records of the American seaman as a fighting man.

In the naval war with France in 1798-1799, the Coast Guard (which was then known as the Revenue Marine) actively participated. The operations in the West Indies and Caribbean included 22 cap-

tures of French armed vessels. Eighteen of these captures were by cutters and in two other captures cutters participated. One engagement was notable in that a cutter with 16 guns and a crew of 70 men captured a French vessel of 44 guns and a crew of 200 men—a vastly superior force.

In the war of 1812 one of the outstanding naval engagements was that of the cutter *Eagle* with the British brig *Despatch* and her consort. The *Eagle* fought until she was forced ashore; then landed her guns on a bluff and kept up the fight. When her solid shot were exhausted it was found that the British shot were of the same caliber, so these were dug out of the bluff and fired back until finally the powder was expended and the *Eagle's* captain was forced to surrender.

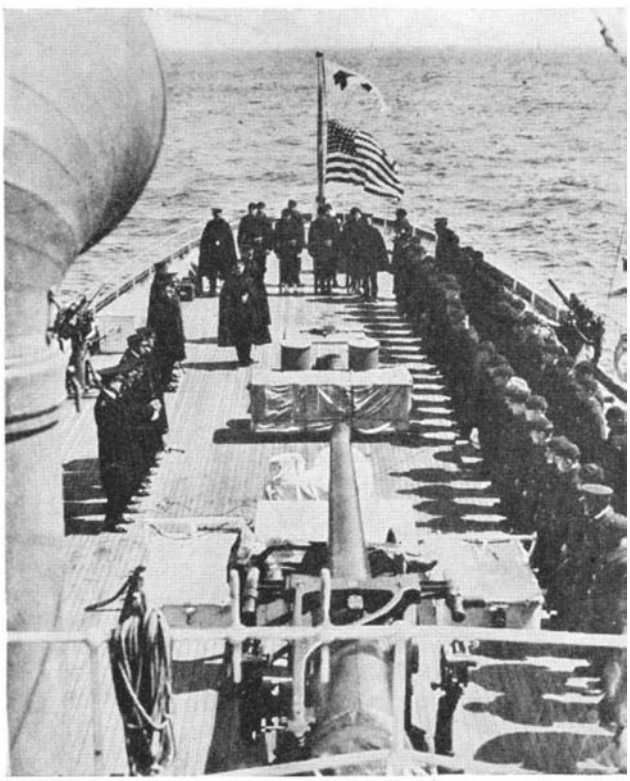
DURING the World War, the Coast Guard automatically became part of the Navy, and its officers, men, and ships actively engaged in all naval activities. Six cutters were overseas based at Gibraltar and for 12 months acted as ocean escorts for convoys from Gibraltar to England and return, comprising 60 percent of the vessels detailed for this duty.

The International Ice Patrol (the third duty mentioned), strange to say, conveys no idea to the average American of what this patrol of North Atlantic ship lanes really is.

The sinking of the *Titanic* in 1912, after her collision with an iceberg, so shocked the maritime nations of the world that a conference was held and a convention entered into by the principal maritime powers establishing a patrol of the transatlantic steamship lanes during the season when ice from the Arctic, Labrador, and Greenland becomes a menace, to observe the position, drift, and so forth, of these icebergs, and to send out warnings and information by radio of the ice conditions.

This duty was delegated to the United States, each of the maritime nations agreeing, in proportion to its deep sea tonnage, to re-imburse this nation for the expense of the patrol. The United States Government selected the Coast Guard for this important duty and each year since 1914, with the exception of the war years 1917 and 1918, the Coast Guard cutters have performed this duty so well that no vessel using the patrolled lanes has met with disaster from ice.

The patrol usually begins in March and is continued until the senior officer of the patrol force decides there is no longer any menace from icebergs—generally late in June or early in July. Year after year the patrol has been constantly on the job, applying each year accumulated knowledge, better instruments, and the best specialists on the various subjects to be studied and observed. Lieutenant Commander E. H. Smith, U. S. Coast Guard, has made such an intensive study of ice conditions and oceanography for seven consecutive seasons that he is today, without a doubt, the leading authority on ice currents and oceanography along the transatlantic steamship lanes.



Memorial services on a cutter of the International Ice Patrol for those lost on the *Titanic*, held each year on the anniversary of the tragedy, where it took place

Radio, of course, is the factor that makes the ice patrol feasible. During the years 1928, 1929, and 1930, the number of words sent and received by the patrolling vessels were 450,400; 807,737, and 688,723 respectively.

Even those most remotely located from the coast know what an S.O.S. call is; to those in any way connected with the sea, it means peril and perhaps death. The Coast Guard on its 36 cruising cutters, 15 destroyers, and at its 10 shore radio stations, has alert and intelligent radiomen "listening in" for this call every minute day and night, or, in Service parlance, "guarding the 500 KC channel." The 500 kilocycle channel, as you perhaps know, is set aside for S.O.S. calls only, and no interference is permitted.

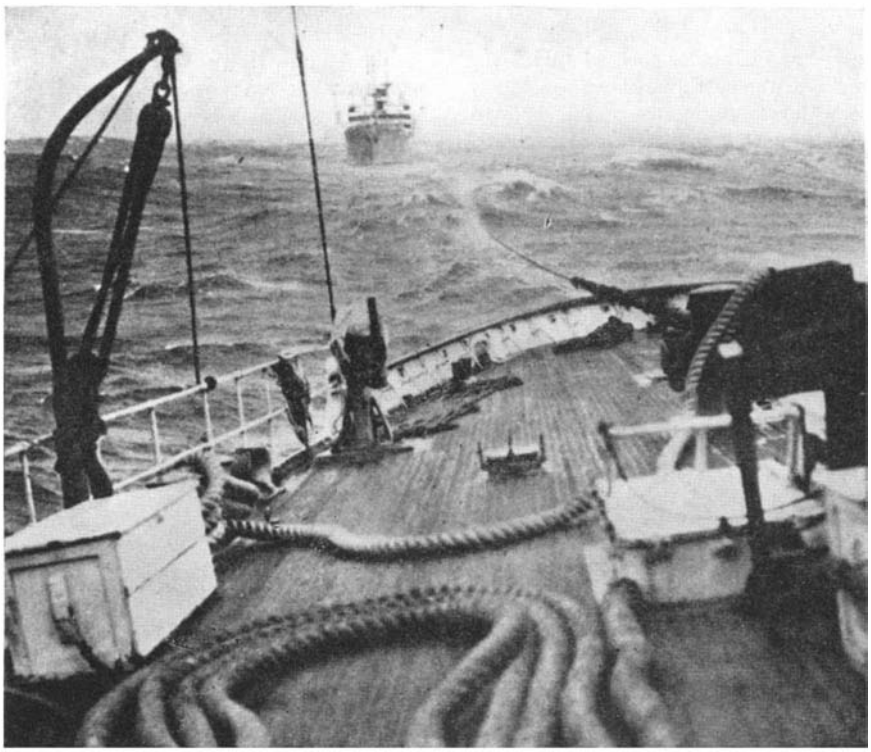
Immediately an S.O.S. call is picked up, all cutters anywhere near proceed at full speed towards the locality indicated in the message. The senior officer afloat takes charge of directing the movements of the vessels, designating those necessary to proceed to the rescue and directing those whose services are not deemed necessary to resume their regular duties.

The Coast Guard has also a small but very efficient aviation corps, which is used in assistance work. One of its officers, Lieutenant Commander E. F. Stone, was chief pilot of the *NC-4* (the first plane to make a transatlantic flight) and also one of the first officers to make a flight in a plane catapulted from a ship's deck, he having assisted in designing the catapult.

Last summer there was an explosion aboard a tanker off the New Jersey coast and two engineer officers were severely burned. A radio message was sent to the Coast Guard Air Station at Cape May. Immediately an amphibion plane was sent to the ship. Landing alongside the tanker, it took the two men off and in less than two hours from the time the message was sent had the men in a hospital in Philadelphia, thus saving their lives. Twice since, similar flights have been made to ships at sea, either to take doctors to sick or injured persons or to transport them to hospitals.

One of the duties performed by the Coast Guard that is most important is the patrolling of regattas and marine parades in order to protect life and property. The last Annual Report of the Coast Guard shows that during the fiscal year ending June 30, 1931, the Service patrolled 114 regattas and marine parades during which no loss of life occurred, and only minor casualties among the sightseeing craft with absolutely no interference with the contestants.

ON rivers and streams the Coast Guard also serves. The Service maintains and operates two cutters for flood relief on the Mississippi and Ohio Rivers. During the great flood of the Mississippi and its tributaries, in the spring of 1927, the Coast Guard sent 128 vessels and boats manned by 674 officers and men for relief work in the inundated areas. These vessels cruised 75,000 miles in the relief work; took 43,853 persons from perilous positions to places of safety; saved 11,513 head of live stock, and distributed over 7000 tons of Red Cross relief stores. So far as known, only one life was lost in the



Coast Guard cutter *Tampa* towing the disabled motorship *Silver Maple*. The cutter *Mojave* may be seen in the distance acting as a rudder for the latter ship

area where the Coast Guard was in action and this case was beyond human aid.

Without hesitation, the statement is made that the officers of the Coast Guard are more familiar, have better information in regard to the inhabitants and possibilities of Alaska and the navigation of its waters than the personnel of any other branch of our Government.

Since 1867, when Alaska was purchased from Russia, Coast Guard cutters have constantly and continuously cruised in the waters of this territory, first for exploration and investigation; later for protection of the fur-bearing seal herds; then for enforcing the game and fish laws, suppressing illicit traffic with natives in liquor and firearms, preserving law and order, and in rescue work among the whaling fleet and destitute miners, prospectors, settlers, and natives.

IT would be impossible to give in detail the work performed by the cutters that make these northern cruises, but in general they carry and bring back mail from the outlying and inaccessible villages; give medical and dental aid to the natives and residents; transport teachers, missionaries, and destitute persons; dispense justice; and apprehend violators of the laws of the land. In addition, they make scientific studies of the climatic and other conditions of the regions visited. The results of these studies have proved very valuable. For example, when the Army Air Service was making plans for its Round-the-World Flight, its officers conferred constantly with Coast Guard headquarters seeking information as to weather and landing conditions, harbors, and on many other points necessary to make the flight a success. Others who have contemplated, attempted, or made flights in these regions have called on the Coast Guard for information and suggestions.

It was the Coast Guard that introduced reindeer into Alaska in order to furnish an additional food and clothing supply.

The Coast Guard is primarily a law-enforcing agency, especially in regard to maritime and navigation laws. Its inception was due to the fact that after the disbanding of the Continental Navy the new republic had no armed seagoing force, yet was fast developing a merchant marine of importance, and it was apparent that an armed force was necessary to protect it from the depredations of the piratical craft especially active along the Gulf coast, in the West Indies, and Caribbean. It was also necessary to have a force to see that private ships engaged in commerce observe our and international maritime laws. In addition to these requirements, a force to suppress smuggling and to protect the customs revenue was mandatory, and the Coast Guard was especially entrusted with this duty. So long as it was apparent that smuggling on a large scale was being carried on along the coasts and borders of the country, the Coast Guard was active in suppressing it, but for a long period the only smuggling which the Coast Guard actively engaged in combatting was that of narcotics and aliens until 1920, when the 18th Amendment and the Volstead Act went into effect.

Those entrusted with enforcing all Federal laws did not appreciate at first the tremendous problem confronting them in carrying out the provisions of this amendment and the enforcement acts until a couple of years after they had become operative. When the magnitude of the task became apparent, a study was made of the entire subject in an attempt to determine what Federal law-enforcing agencies could best be employed.

THEN it was that means to disperse the various "rum rows" and put a stop to the wholesale smuggling of liquor were sought. Enthusiastic prohibitionists wanted the Army and Navy used to attain the desired results. This plan was squelched at the outset by the cogent reasons submitted to the President by the Secretaries of War and the Navy as to why these services should not be used to accomplish the desired results. The Coast Guard when first established was assigned as one of its major duties: "The protection of the Customs revenue." Therefore, there was no reason why this service should not be used for the purpose that brought it into being.

Congress immediately made appropriations to provide additional personnel and matériel to enable the Coast Guard to perform the duty of preventing smuggling and enforcing the statutes relating to it in our efficient manner which was perfectly logical and in accord with its *raison d'être*.

The public's mind should be set right on one point. The Coast Guard is not a prohibition enforcement agency. It has absolutely nothing to do with the distilling, brewing, selling, or possession of beverages in excess of one-half of one percent alcoholic content in public or private houses ashore. These are functions of the prohibition enforcement unit, and the officers and men of the Coast Guard have none of the authority vested in the personnel of the prohibition officials by law.

To perform the many duties assigned to the Coast Guard, the following is a list of its matériel:

36 cruising cutters (406-2000 tons).
15 Coast Guard destroyers (1110-1308 tons).
33 harbor craft (52-138 tons).
5 special craft.
270 patrol boats (75-220 tons).
29 miscellaneous boats.
300 Coast Guard stations.

The above are manned by 472 commissioned officers, 12 temporary commissioned officers, 879 warrant officers, 269 temporary warrant officers, and approximately 11,000 enlisted men.

PRESERVING PROOF OF INVENTION

Adequate Evidence of the Date of Conception Will Aid the Inventor if His Claims to Priority Are Contested

THROUGHOUT its entire history, from 1845 to date, SCIENTIFIC AMERICAN has sought to aid inventors in many ways. At various times during this period distinguished inventors and those interested in the progress of the arts and sciences have foregathered in our editorial offices, and some of the most noted inventions have been first proclaimed and discussed in detail at these informal meetings.

In 1849 one of the early sewing machines was brought to our offices for a demonstration by its inventor, A. B. Wilson. In 1877 Thomas A. Edison showed the editor the first crude model of the "talking machine" that was destined to become the forerunner of the highly developed modern phonograph. His demonstration aroused so much interest that, it is said, the crowds which were attracted when word of the invention spread, threatened for awhile to overload and break through the floor of the room.

Among the other early inventors who were visitors to SCIENTIFIC AMERICAN offices were Samuel F. B. Morse, Elias Howe, Captain James B. Eads, Captain John Ericsson, Dr. R. J. Gatling, and, at a later date, Peter Cooper Hewitt.

IT has now occurred to us that many present-day inventors, during the present economic depression, have been unable to seek patent protection for their inventions because of lack of funds to meet the expense incident thereto. It is desirable that an application for patent be filed as soon as possible after an invention has been completed, for while the first to file an application will not be given a patent for that reason alone, yet in a contest between two applicants, each claiming to be the inventor of the same thing, the one who delays filing an application may find it difficult to prove his priority over one who filed earlier, and unless he can show a good excuse for not filing earlier, the delay in filing may in itself be a bar to his getting a patent. In an interference contest in the Patent Office it is essential that an applicant produce proof of the date of conception of the invention and its disclosure to others; the date when a drawing, sketch, or model was made, and in addition, where the filing of the application has been delayed, the applicant must show a good excuse for delay. Lack of funds, sickness, and so on, have been regarded as sufficient.

To all inventors who are unable to file an application for patent we suggest that they write a brief description of their invention, accompanied by sketches or drawings, explaining its object, and, if they have disclosed the invention to others, include in the statement the name and address of those to whom they made such disclosure; also explaining why they have delayed filing their application, as for instance, that they have been out of work for some time or are receiving unemployment aid, or anything that has made it impossible for them to proceed. The statement should also record the date when they first disclosed it to others and where such disclosure was made and under what circumstances. Drawings should be dated and signed, and if the drawings have been shown to others they should also sign and date the drawings at the time.

HAVING done this, put all in a sealed envelope and send by registered mail addressed to yourself or some one in whom you have confidence. Upon receipt it should not be opened, for its value as evidence that the contents were prepared at the date of mailing rests on the fact that the letter has not been opened. In addition to the postmark which will show when it was mailed, the registration number and the records of the Registration Division of the Post Office will also constitute valuable evidence which will be available when required. Of course, the sealed letter should be carefully preserved in some safe place.

By this simple expedient inventors can preserve proof which may be the means of assisting them in an interference contest when seeking a patent, and also in proving priority when the validity of the patent is attacked in an infringement suit.

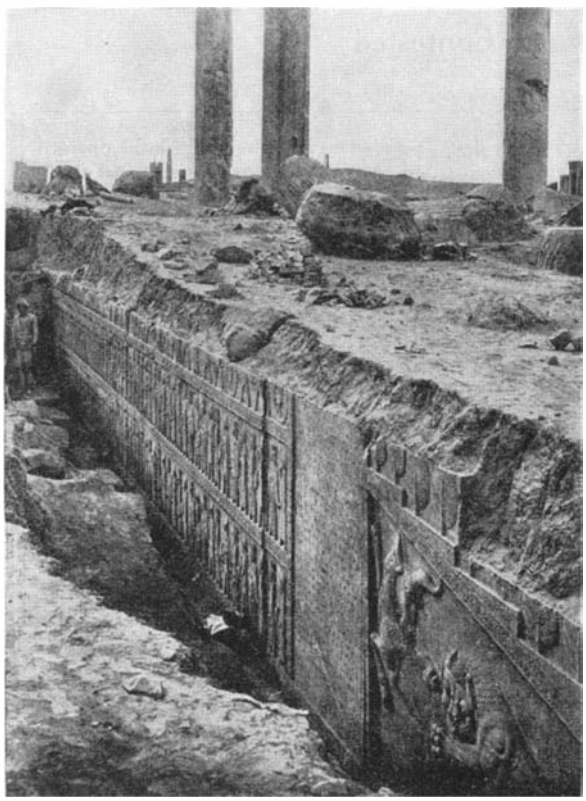
While the foregoing suggestion is offered to assist inventors during this period of economic depression, it will of course be useful and effective at all times in preserving proof for future contingencies. Inventors should not work in secrecy but should inform their friends in whom they have confidence as to what they are doing, and show and describe their sketches, drawings, and models to them. If they do work in secrecy, they alone can testify as to what they have done and when it was done, but such testimony, to be effective, must be corroborated by other witnesses.

IN the accompanying article is detailed a method whereby inventors, unable to pay the expenses of applying for patents for their inventions, may preserve proof thereof until such time as they are financially able to proceed with the usual process of seeking a patent. The method outlined presupposes that the inventor has available a safe place where papers may be fully protected against fire, theft, and so forth. When such is not the case, the inventor's evidence of conception may be irretrievably lost.

In order to prevent such a possibility, *Scientific American* will undertake to act as a depository for the documents prepared as suggested. Should you desire to place such papers in our care until such time as you may want them returned or forwarded to some patent attorney of your own selection, you may rest assured that they will be carefully preserved and their contents revealed to no one; in fact, they will not be opened. All you have to do is to seal the envelope containing the papers, indorse it with your name and address, and mark it "Not to be Opened." Then enclose this in another envelope addressed to John P. Davis, Treasurer, Scientific American Publishing Company, 24 West 40th Street, New York, N. Y., and mail. When received, both the outer and the inner envelopes will be dated, numbered, and filed in a safe place awaiting your further instructions. Receipt of such documents will be acknowledged, and you will be informed of the identifying number that has been assigned to your envelopes. In order to avoid unnecessary accumulation, these papers will be held for a period of two years and then destroyed without opening, unless we hear from you with definite instructions before the elapse of that time. This is a purely gratuitous service to our readers.—*The Editor.*

The Glory of Persian Art

Hidden as the Result of a Drunken Orgy; Uncovered by American Archeologists



Relief sculptures of one of the great stairways on the front of a palace just discovered at Persepolis

THE entire cultured world was interested when Dr. James Henry Breasted, Director of the Oriental Institute announced on January 22nd that discoveries of the first magnitude had been made at Persepolis, the magnificent capital of the Persian Emperors and the Versailles of Darius and Xerxes. Dr. Breasted says: "One tradition has it that Alexander the Great, in 330 B.C., sotted with wine and urged on by his lady-love of the moment, set fire to the roof of one of these palaces, and thus sent up in flame and smoke a supreme expression of ancient Oriental genius. It was a disaster which marked the end of the evolution of Oriental civilization in western Asia and the destruction wrought by that conflagration devastated and wrecked forever most of the works of art which made the palaces of Persepolis the great world center of culture and civilization under the Persian Empire."

In our issue of October, 1932 we reviewed briefly the status of the 12 field expeditions of the Oriental Institute. The Institute's Persian Expedition, directed by Dr. Ernst E. Herzfeld, probably the ablest living specialist in Persian archeology, now reports two finds of the utmost importance which should not be confused.

Earliest in date is a Stone Age village, two miles from Persepolis, which is 6000 years old. Here lived the forebears of the Persian Emperors. The village is in a mound 300 by 600 feet and only 10 to 12 feet in height.

The walls of the *adobé* houses are preserved in places to a height of six or seven feet. There is a narrow street or alley extending the length of the little settlement, and a modern visitor walking along it can look into the houses. Through the doors, and the earliest known windows ever found, one can see mural decorations of red ochre water color still visible on the walls. Standing about on the floors are household utensils of pottery, fireplaces with burned clay fire-dogs still in position, and pottery vessels containing the remains of foods, especially the bones of probably domesticated animals. In some of the dishes lay the flint knives with which these ancient people had last eaten about 6000 years ago.

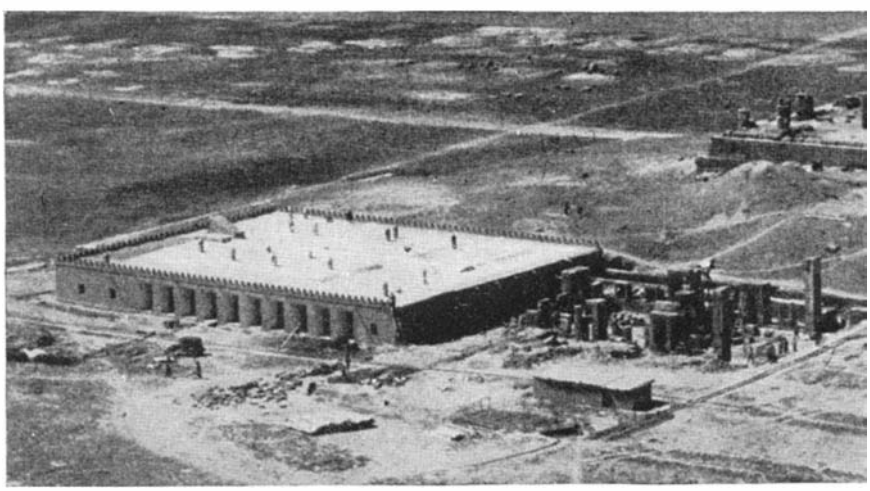
The polychrome designs and motifs painted on the pottery mark a new chapter in the history of prehistoric art. Dr. Herzfeld says: "With the exception of some potsherds of the Stone Age in Babylonia, the finds that have come out of this Stone Age hill by Persepolis, both in age and in beauty, throw everything later into the shade." "Such remains," says Dr. Breasted, "disclose to us the earliest prehistoric ancestry of the civilization which reached its culmination in the palaces of Persepolis."

That evidences of Stone Age culture and of subsequently imperial splendor should be discovered side by side is a triumph of archeology in its striving to bridge vast periods of time and to reconstruct the life and history of these interesting peoples.

THE members of the Persian Expedition have been housed in the harem apartments of Darius the Great which have been roofed over, making comfortable living quarters and providing storage space for the recovered sculptures.

Under 26 feet of rubbish and masonry at Persepolis, Dr. Herzfeld has uncovered a series of wall sculptures which if set together would form a vast panel of reliefs five or six feet in height and almost 1000 feet long.

"The discovery is one of the greatest and most important in the history of archeological research anywhere," said Dr. Breasted. "It not only far surpasses any archeological disclosure ever made in the history of such research in Persia, but there has never been any



The harem of Darius the Great, roofed over and restored by Oriental Institute's Persian Expedition at Persepolis, now serves as their headquarters

discovery like it anywhere in western Asia since archeological excavation began there almost a century ago."

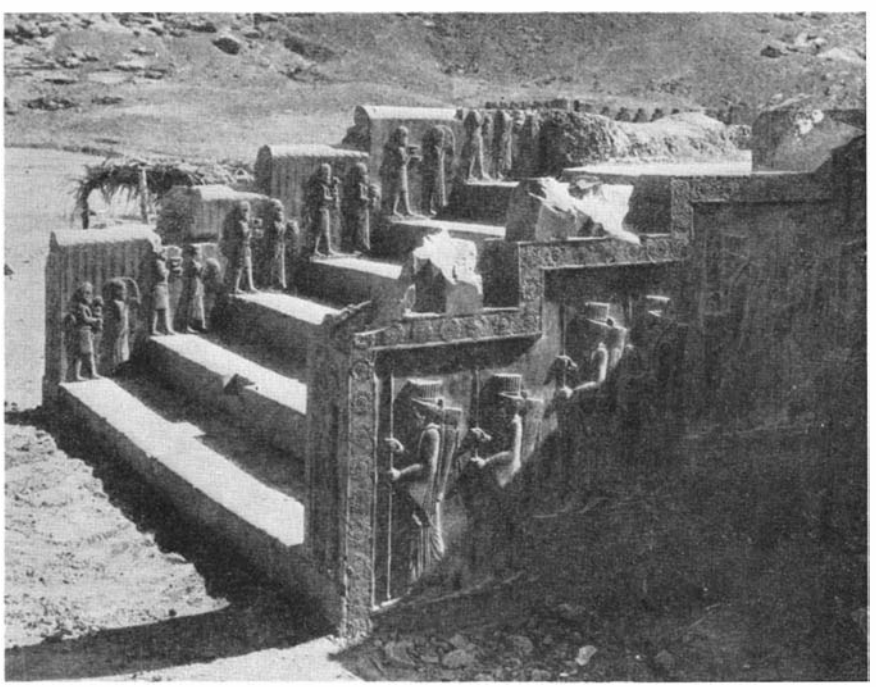
The walls of the splendid palaces, which stood on the gigantic terrace of Persepolis overlooking a mighty plain encircled by mountains, were of sun-dried brick, but the colonnaded halls, the windows, and the great doors were done in black stone which was polished like ebony.

The friezes and sculptured scenes were embellished with colors which are all lost except in one relief just discovered by Dr. Herzfeld. This single example had been sheltered from the weather under rubbish for centuries. Now uncovered, it reveals the Persian Emperor wearing a robe bordered with scarlet and purple, shoes of scarlet, and other finery in royal hues.

IT was due to the disintegration and final fall of the great mud-brick walls that the newly discovered sculptures were preserved, protected from the ravages of weather and vandalism through the nearly 2500 years since they were created. The carvings, which include a series of historical inscriptions of the greatest importance, are as fresh as the day when the sculptors' chisels touched them for the last time.

When the Moslems overflowed into this region in the 7th and 8th Centuries of the Christian Era, they battered to pieces the heads and faces of the sculptured figures they found still visible above the ground at Persepolis. But the sculptures which the Oriental Institute has now discovered escaped their notice and therefore constitute an epoch-making contribution to the history of ancient art.

The subject matter of the reliefs is a magnificent *durbar* representing a great group of Persian and Median officials standing with the gorgeously uniformed palace guards of the Persian Emperor drawn up at one side to receive the ambassadors of 22 subject nations who approach from the other side bearing their tribute to Persia. The execution of the scenes displays unparalleled beauty and refinement of detail. The palace guards, consisting of footmen, horsemen, and charioteers, form a superb ensemble. In the sculptor's representation of each chariot wheel, the bronze nail which was dropped through a hole in the end of the axle outside the hub to prevent the wheel from coming off, is depicted in every detail; each nail consists of a beautifully sculptured female figure, carved with the delicacy of a cameo in an area not as large as a postage stamp, the legs of the figure forming the stem of the nail which is inserted in the hole in the axle.



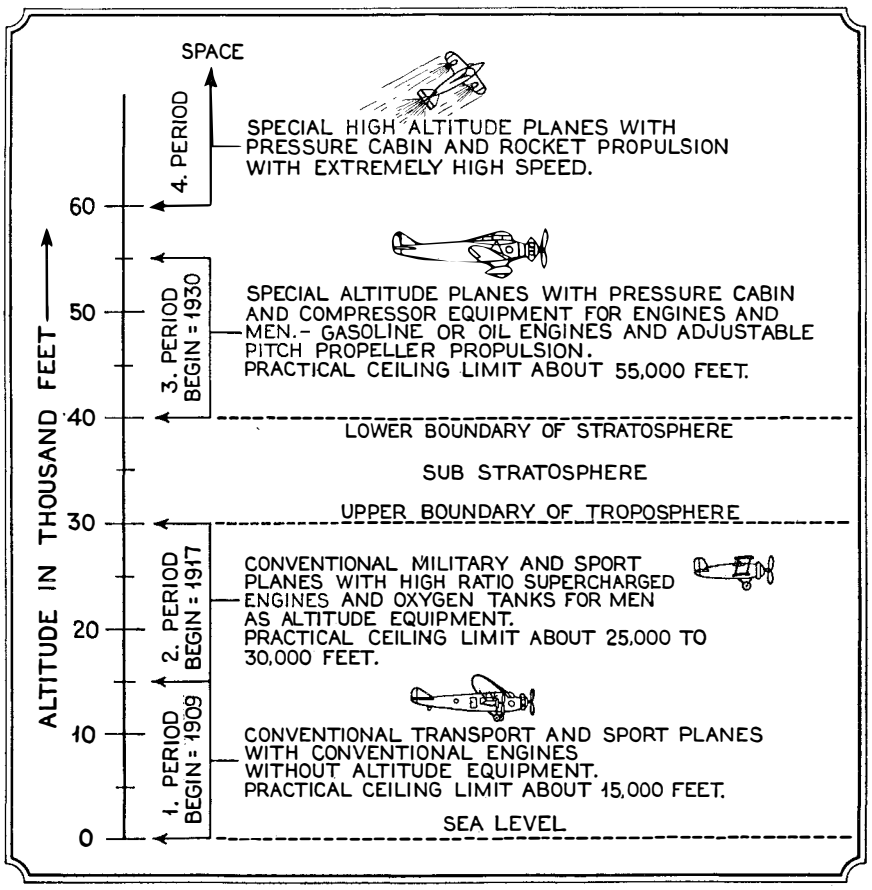
Right: **The step was repaired by a carved piece set with lead. A defect in the figures was remedied by carved lead.** ***Below:*** **Small stairway with relief sculptures in stone**

The grand double staircase leading from the main entrance to the terrace level above the plain where the beautiful palaces of Persepolis were located

Persepolis lies high on a plateau among the Persian mountains, back of the Persian Gulf, 40 miles from Shiraz. The Oriental Institute holds a concession to all the surrounding ancient sites within a circle of 13 miles with Persepolis as its center. The latest discoveries are helping to recover the long cultural development which went on for ages among the Persians and their predecessors in this region, as they advanced from the Stone Age to the magnificence of Cyrus the Great.

The Truth About High-Altitude Flight

By W. H. EVERS



Four periods in aviation, based on altitudes attained or to be attained. The author deals mainly with the third period—engine flight in the stratosphere

(Concluded from March)

FANTASTIC figures have been published about plane speeds in the stratosphere, ranging from 500 to 1200 miles per hour. Let us see, however, what speeds and other performances can really be expected in a high-altitude plane and how the difficulties of thin-air flying are being solved on planes now in the state of design or under construction.

We know from the discussion published last month that the main problems of high-altitude flying are to provide sufficient oxygen for breathing, to keep the bodies of pilot and passengers under sea-level pressure, to feed the engine the necessary air to keep the power output constant up to the service lane, and to retain the grip of the propeller in the thin air for maximum speeds.

The air consists mainly of about 79 percent nitrogen and about 21 percent oxygen at sea level. The oxygen content diminishes slightly with altitude, but the difference being only 0.5 percent in 50,000 feet makes this negligible. In this one respect nature favors the airplane designer; the only thing necessary to provide sufficient oxygen for the lungs is to compress the thin air to sea-level density. As this compression is necessary anyway to provide the proper pressure for the continued functioning of body and mind of high-altitude travelers, two problems are solved at one stroke. Thus it also becomes unnecessary to carry heavy steel bottles of pure oxygen and other paraphernalia for respiration.

As the oxygen content of the air at altitudes greater than 50,000 feet is replaced more and more by hydrogen, a different solution of this problem will be necessary for rocket planes, flying at altitudes of about 100,000 feet or over.

The simplest solution of high-altitude flying would appear to be to use conventional planes and furnish each individual with an airtight suit and helmet, such as divers wear, with tubes for air and pressure supply. However, the lower outside pressure would make the fabric suit bulge out like a balloon. Also, any movement of the wearer would be almost impossible and so an outfit of this sort would be impracticable. Stratosphere planes are therefore designed on the lines of an "inverted" submarine. The cabin is hermetically sealed to keep compressed air inside, whereas the submarine is built to keep water out. In both cases the hull or shell serves a common purpose to protect crew and passengers within, against dangerous elements without.

THE air-tight compartment or pressure cabin of the American plane designed as long ago as 1927–1928, had a cylindrical body with hemispherical ends and double walls, the outside being the skin of the fuselage, with an air space between the walls. Double transparent casings and panels were provided for the pilot's observation dome and cabin windows. The intervening spaces for air circulation prevent excessive condensation of moisture from exhaled air. The space between the two cabin walls served different purposes; it would provide a means for cooling the compressed air, which would serve at the same time to heat the cabin and to reduce the difference in temperature between the outside and inside walls, thus preventing undue stresses within the metal and joints. This will be clear if we keep in mind the fact that the inside wall of the pressure cabin is heated to almost room temperature, whereas the temperature of the outer wall is influenced by contact with the outer air at about 60 to 80 degrees below zero, Fahrenheit.

In this cabin the pilot and passengers would be comfortably and safely located and protected against the thin air and bitter cold outside. A constant supply of fresh air at sea-level density would be fed to the cabin from beneath the floor and discharged again by an automatic valve, after circulation. The air would be supplied by a compressor at a rate not only sufficient for breathing but to keep the humidity inside the cabin always below 70 percent.

The pilot's seat, in this American design, is located on an elevated platform in the forward end of the cabin. Overhead is the observation dome, permitting good vision in all directions for safe starting and landing without the use of a periscope. After the pilot has reached his flight lane above weather and clouds, there is not much for him to do if the stabilizer is set for

horizontal flight and the rudder for direction. No unexpected gusts of wind can disturb the balance of the plane and all that remains to be done is to watch the instruments and to keep in touch with ground stations or ships by radio about the weather below, in case a forced landing should become necessary.

The altitude plane is designed to be controlled in the conventional manner by control column and foot pedals. All connecting elements to the control surfaces have to pass through airtight connections without creating additional friction, because hard working controls not only put undue strain on the pilot but also make the ship unstable and unpleasant to fly.

Of as great importance as the pressure cabin for high-altitude flying is an engine which can provide power for the anticipated high speeds ten miles up. Present engines are made to work best in the dense air close to the surface of the earth. We have shown previously that the engine is a glutton for air, because with each gallon of gasoline, weighing about six pounds, the carbureter mixes 102 pounds of air for most efficient combustion and power output. At sea level this air amounts to about 1350 cubic feet, but almost 8800 cubic feet are required at an altitude of ten miles.

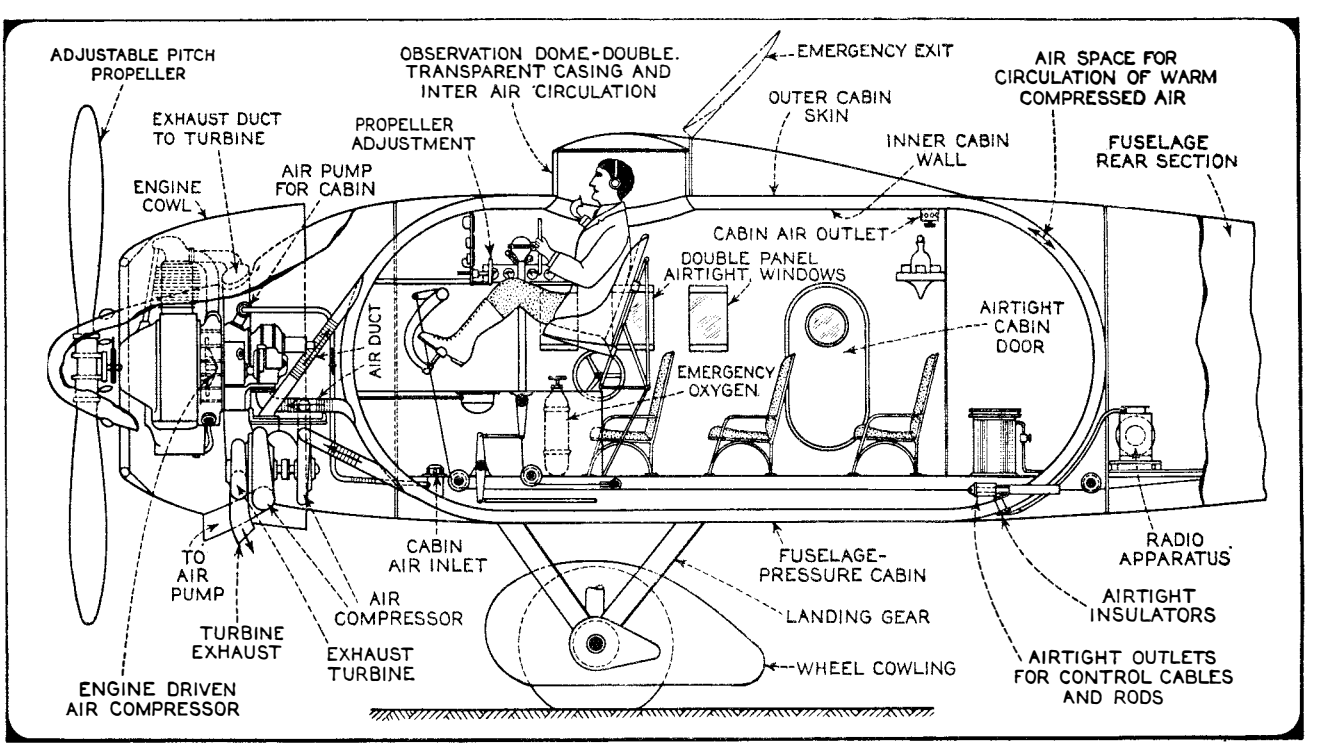
A 400-horsepower engine will consume about 38 gallons of gasoline per hour; 3876 pounds or 50,800 cubic feet of air are required to satisfy the need of the carbureter at sea level. For equal performance at 50,000 feet, the fuel and air consumption by weight remains the same but the volume of air required per hour rises to about 334,000 cubic feet. To feed this vast volume of air to the carbureter it is necessary to employ an air pump or compressor to reduce each 6½ cubic feet of thin air to one cubic foot, or the density on which engine power depends. This sounds simple, since engine-driven compressors for lower altitudes have been in use since 1917. However, there is one objectionable feature about this method above 30,000 feet, up to which the power gained and required are almost equal, because at 50,000 feet altitude it would require nearly 30 percent of the engine power to drive the compressor and this power would be lost for the real purpose of altitude flying —the realization of high speed.

THEREFORE, another source of power has been tapped which generally is wasted; namely, the hot exhaust gases of the engine. Experiments in this field have been going on in different countries for years and the United States Army Air Corps in cooperation with the General Electric Company has obtained very promising results with exhaust driven compressors. [See page 299, May 1932 SCIENTIFIC AMERICAN.—*Ed.*] The temperature of the exhaust gas when entering the collector pipe is about 1200 degrees, Fahrenheit, and its average velocity about 800 feet per second. According to the heat balance of a 400-horsepower engine, the absolute power in the exhaust gases at 50,000 feet is around 440 horsepower, of which about 260 horsepower are utilizable in a gas turbine. With a turbine efficiency of 50 percent, about 130 horsepower could be utilized which would be sufficient to drive the compressor, and the full power of the engine could be made useful for speed.

Although the air supply of the engine thus seems to be solved, another difficulty arises; the cooling of the compressed air before it enters the carbureter. Some of us probably have observed when pumping up a tire with a common hand pump, that the lower part of the cylinder and the rubber hose become hot. This phenomenon is caused by the rise in temperature as the air is compressed to tire density. Exactly the same thing happens to the thin and cold air when compressed to sea-level conditions. The temperature increase is about 200 degrees, Fahrenheit, or from about 70 degrees below zero to 130 degrees above. The air is too hot to be fed directly to the engine, and as has been mentioned before, becomes a source of heat which is utilized for heating the cabin and for equalizing the temperature of the outer and inner pressure cabin walls before it is supplied to the carbureter of the engine.

There are still other obstacles to high-altitude flight and although it sounds rather paradoxical, one of the difficulties is to keep the engine cool at 70 degrees below zero. The cooling effect of the air decreases with its density and in spite of the low temperatures at 50.000 feet, the cooling effect is only about 70 percent of what it was at sea level. If liquid cooled engines were used, the cooling system would have to be kept under pressure

(*Please turn to page* 250)

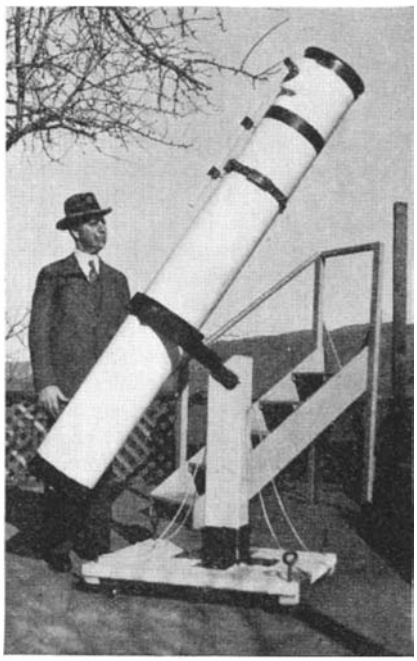


Redrawn from a sketch by the author

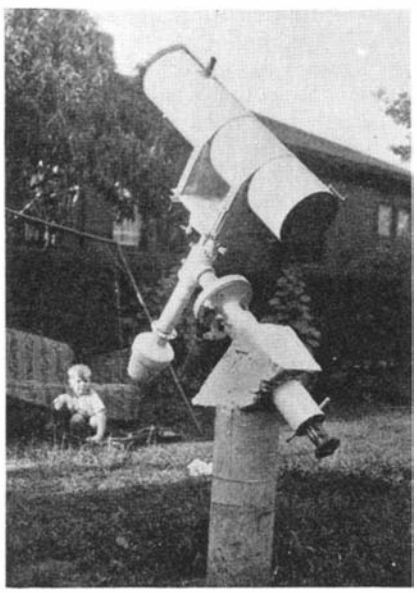
As long ago as 1927, a plane was designed in the United States for stratosphere flight. The author describes this plane, shown diagrammatically above, and uses its principles as a basis on which to explain the problems of stratosphere flight

More Amateurs' Telescopes

LIKE "Old Man River," the hobby of amateur telescope making, popularized by this magazine during the past eight years, just "keeps rollin' along" right through the alleged depression. Old Man River has riz, in fact. More copies of the book "Amateur Telescope Making" have been distributed, and more telescopes made by amateurs, during the past year than ever before. More people are rubbing one disk of glass on another to make concave telescope mirrors at the present moment than at any time since the universe began expanding from a geometrical point.—*The Editor.*



J. B. Duryea, 1011 Pacific National Bank Building, San Francisco, California, with a 10¼-inch telescope made during occasional trips to his mountain cabin, at a cost of 60 dollars. He writes: "With it the Great Nebula in Orion is as clear as a patch of cloud in an otherwise cloudless sky, and the attendant stars blaze in resplendent glory. The disk of Jupiter appears large enough to reach from the edge to the center of the moon when the full moon is seen as a naked-eye object. Our own moon has taken on an aspect that I had never even dreamed of. The craters, Tycho, Copernicus, Eratosthenes, and others, are as clear and distinct as in any photograph of the moon that I have ever seen." Mr. Duryea has also written several books on insurance selling. One is "When to Stop Talking"



An 8-inch telescope of 32 inches focal length, made by Charles H. Boyd, 3315 Ave. L, Brooklyn, N. Y. He states that he hit on the paraboloidal curve by luck! Some hit on another curve—without luck

J. H. Nelson, 1036 41st Street, Brooklyn, N. Y., and his 6-inch tubeless telescope. Its "spinal column" is a channel bar of aluminum. This is Mr. Nelson's second telescope and it magnifies 192 diameters. "It took me five months to make my first mirror and 12 hours to complete the second. Even slight experience counts in this hobby," he writes. "I have been badly bitten by the telescope making bug"

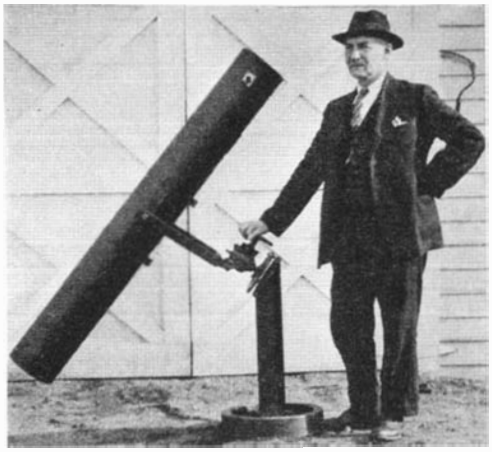
A Newtonian-Cassegrainian combination made by Napoleon Carreau, 1836 Palisade St., Wichita, Kansas. Mr. Carreau is a professional worker, unlike the others

***Left:* Stephen B. Cummings, of Norway, Maine, with his telescopes having, respectively, 7-inch and 13-inch glass mirrors**

A 6-inch telescope constructed of pipe fittings by Delmar C. Lemmon, instructor in biology in the Roosevelt High School, Dover, Ohio. "I found all the work intensely interesting," Mr. Lemmon writes. "When I return home at evening, tired of working with people all day, I spend many pleasant hours in my basement shop working with things. The total cost of materials was about 50 dollars, and the fun was easily worth twice that much"

Right: "It cost me less than five dollars to make," is what George I. Moe of Tacoma, Washington, says. A steering worm from an old car provided the heart of the mounting

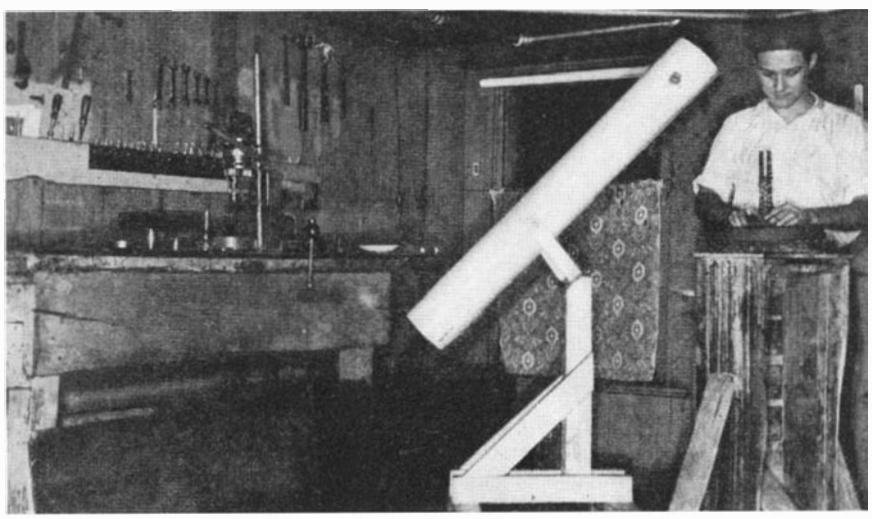
Below: Kenneth N. Reed, 268½ North Los Robles Ave., Pasadena, California and an 84-pound portable nine-inch telescope made at the very low cost of $4.88. Two unique braces take the place of the tube



Left: T. L. Dennis, Prince Bay, New York, with 6-inch telescope on a pedestal built heavy enough to carry a large telescope which he expects to make later

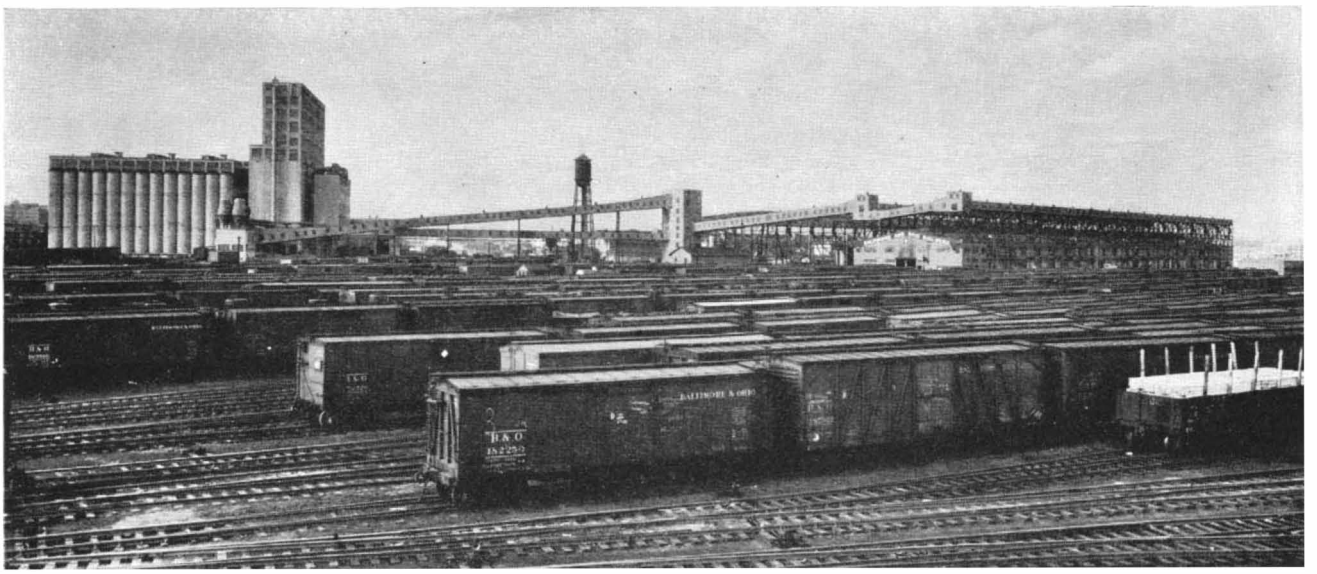
A 6-inch telescope made by L. R. Schuler, 1907 S. Third Ave., Maywood, Illinois, from pipe fittings, bolts, and plates. It has a worm-gear drive, ball bearings, and other mechanical features and, like the others, is entirely amateur work

Lower, left: A 6-inch telescope made by H. E. Devereaux, 253 Horton Ave., Lansing, Mich. Mounted on pipe fittings



Right: Joseph E. Boehm of Chicago, working on a 12-inch mirror for a larger telescope than the instrument shown

What Happens in a



Locust Point elevator, Baltimore, Maryland, showing gallery connections with the piers where grain and general cargo can be handled at the same time

As it is one of our principal underlying sources of national wealth, we have all come to appreciate the importance to this country of our grain trade. Probably everyone has seen the great grain elevators which are found on our seaboard or lake fronts, but few people really appreciate what goes on behind the massive walls. A grain elevator serves the purposes of receiving grain by rail or boat, treating, mixing and storing the grain until wanted for ultimate shipment by steamer or rail. Rapid and efficient methods of handling grain are essential and in the plant of the Baltimore and Ohio Railroad Company at Locust Point, Baltimore, facilities are provided by which a train of 100 carloads of grain can be inspected. unloaded and placed in storage in a little more than three hours; under forced operations an ordinary vessel can be loaded in three hours. The total out-put capacity of the plant is 150,000 bushels an hour of which 75,000 bushels can be concentrated on one vessel, or six vessels can each be loaded at the rate of 25,000 bushels an hour.

The track installation forms a loop which allows the cars to move continuously forward. Physical examination is made by the car inspector to note defects before the cars are opened. Then the car seals are checked by the car inspector and the inspector of the Baltimore Chamber of Commerce, each making his own reports, which are then signed by both and which must agree with each other in all essential details.

The first operation in grain inspection of cars on the track, is to take an average sample which is sent to the laboratory for analysis and grading in accordance with the requirements of the Federal Grain Standards Act.

When the order to unload is given, the car is pulled into the unloading shed. The car, when placed on the bridge of the dumper, is clamped in position, elevated to a height of nine feet, and tilted at an angle of 15 degrees; at the same time the inner holding door is forced inward by pressure, releasing the grain which flows into a hopper of 3000 bushels capacity. The car is then tilted three ways to an angle of 45 degrees, requiring three tilts at this angle to remove all the grain. On the last tilt a baffle plate is placed in the car along the floor, which diverts the grain that has run by in the second end tilt. The car is then brought to a level position and lowered to the track. The clamps are released, and the car is then pushed off the dumper and down the empty track by the next loaded car. It requires eight minutes to unload a car, and, with four dumpers unloading, an average of 25 cars per hour may be maintained.

Samples of grain are taken from the cars for analysis and grading

All grain for whatever purpose handled must be elevated and weighed. From a belt under the car dumper hoppers, the grain is discharged into the bottom of one of 20 elevators and raised by means of endless rubber belts to which are attached buckets that carry the grain to the scales for weighing. The entire contents of a car is weighed at one time, the scales having a larger capacity than that of any boxcar carrying grain. These scales "spout" directly to all shipping bins and to other bins by means of conveyor belts which are strategically placed.

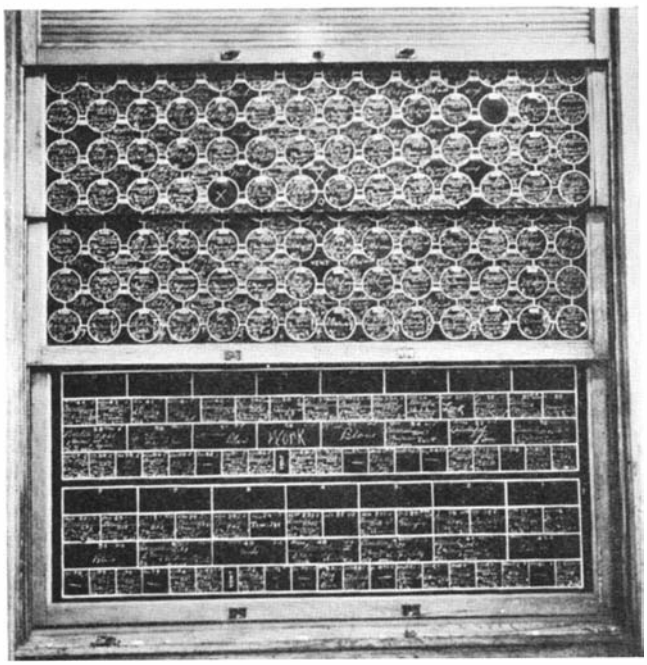
The location in storage of the grain and its subsequent movement in the elevator from bin to bin or while being treated are recorded on a black-board in

Grain Elevator

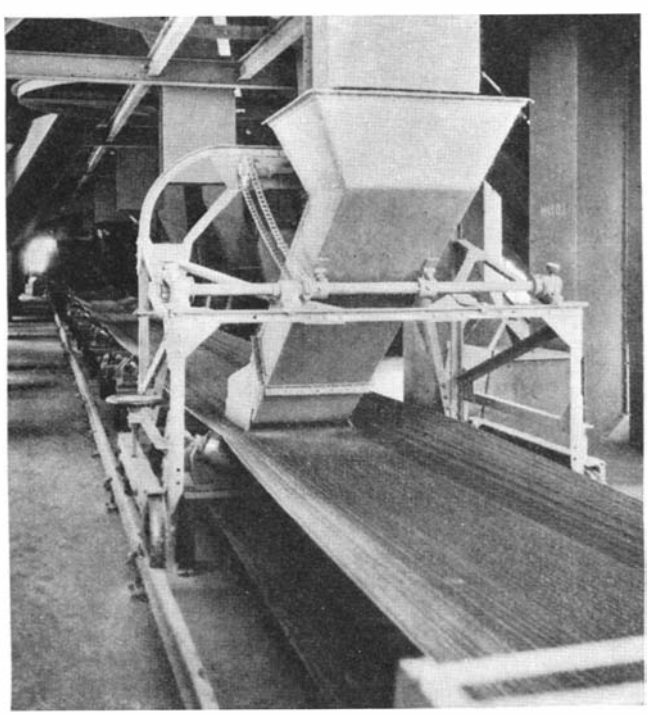
the office. As many as 150 classifications of grain are received, all of which must be stored on different lines of belts so that maximum delivery may be made at any time.

Under the system of operation, washing, drying, cleaning, transferring, or mixing of grain all are carried on simultaneously without interfering with the major operations of receiving and shipping. Whatever treatment is required is done in the so-called "workhouse" and the drier house. The storage house has 182 cylindrical tanks 16 feet in diameter and 96 feet high, and 153 interspace bins, the total storage capacity being 3,000,000 bushels. The grain is moved by conveyor and transfer belts. The Zelany thermometer system provides for taking temperatures at each ten foot level in the bins, the readings being obtained from reflecting galvanometers. This is necessary in order to know the condition of the grain without turning over thousands of bushels. Every possible precaution is taken to remove dust which might cause an explosion. Dust collected throughout the plant is loaded into cars for shipment to manufacturers of cattle feed.

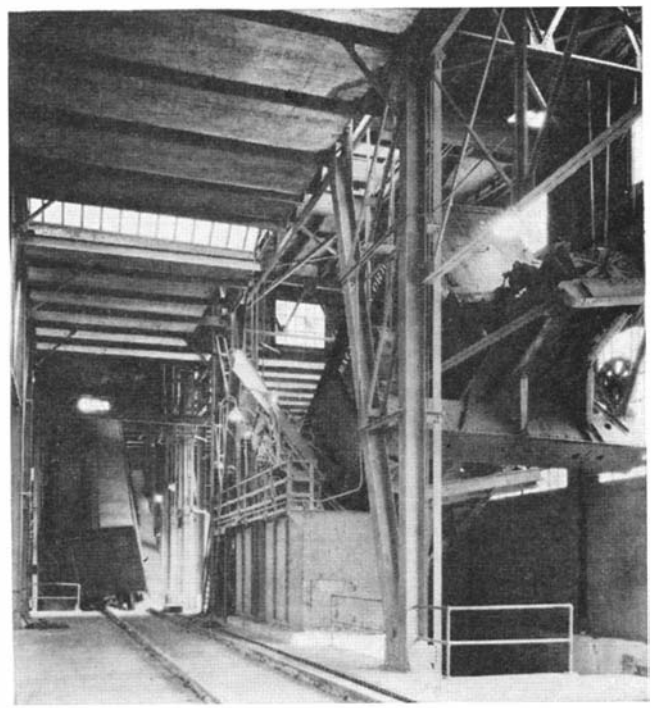
Ships lie alongside the piers and the grain is brought to the holds by means of great closed galleries equipped with conveyor belts. The siding of all the galleries is of sheet asbestos, the roof of gypsum and the floor of concrete, making the gallery construction fireproof.



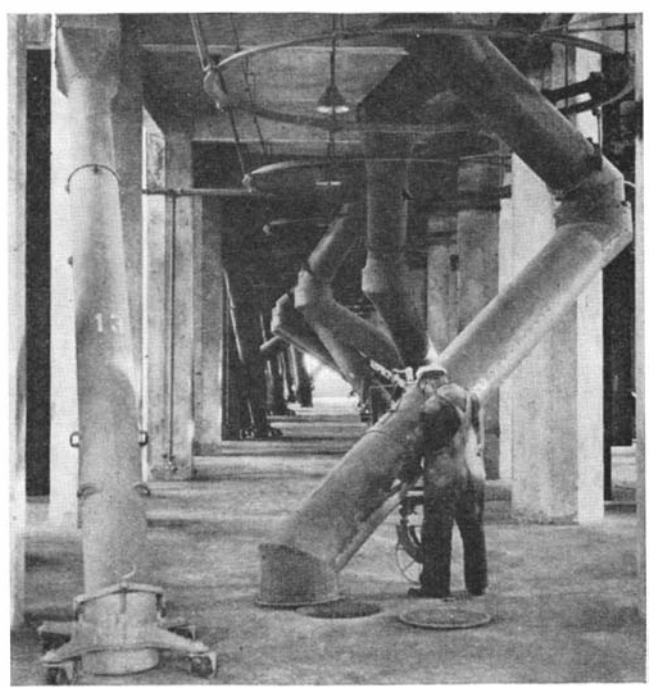
Blackboard record of grain stored in elevator affords a picture of the movement of the grain from bin to bin



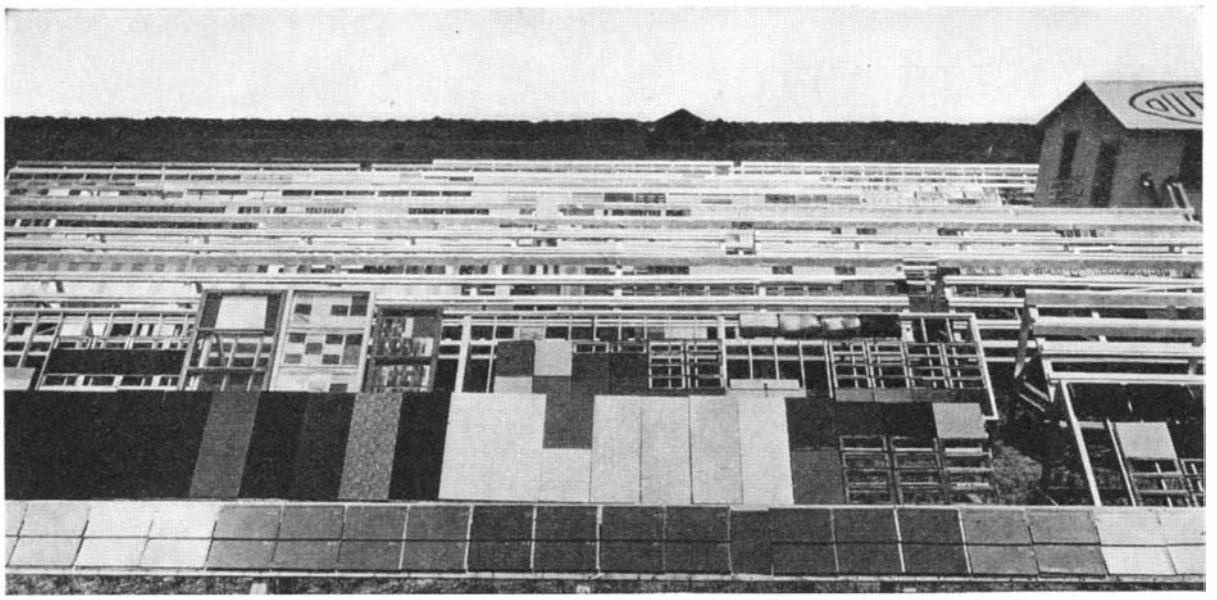
Transfer belts carry grain to the point where it is delivered by a tripper to the belt which reaches the proper bin



Freight cars are clamped and elevated and the grain, released by pushing in the door, flows into a grain hopper



Dispatching of grain in the workhouse is accomplished by spouts which reach the bins within a radius of 30 feet



Outside exposure tests of Fabrikoid are being carried on constantly in widely separated spots throughout the country. Material which is being tested is sent simultaneously to these "farms." This is the Miami, Florida, farm

When Lacquer and Fabric Meet

EVERYONE is familiar with fabrics such as cotton, wool, linen, and silk. These textiles have filled a very definite need in the world's economy for centuries and some of them go back to the beginning of history. There was, however, need for a material which would have a combination of characteristics not found in any one of the older textiles. This material was given to the world by the science of chemistry; it was a lacquered fabric which could be easily worked, which could be washed and which could be adapted to a multitude of uses. Fabrikoid, like all articles using pyroxylin, is a direct descendent of smokeless powder, which made its début shortly after the Spanish War.

ALTHOUGH Fabrikoid has been in use for years, little is known of the exacting processes that are employed in its manufacture. A great plant at Newburgh, New York, turns out a vast yardage each day. The basic material is woven cotton and the first operation is to pick the fabric clean of knots, motes, and misweaves; they may seem unimportant in themselves but they might cause a blemish in the surface of the finished product. Trained operators go over it foot by foot. Half of the roll at a time comes under the inspection of the operator. Then he pushes his chair on its roller carriage to the other side of the inspection rack and the operation is repeated. Before the dyeing operation the goods are tested for tensile strength and quality.

The goods are dyed to a color closely approximating that which will be on the finished coating or face material. In dyeing, the material is run through a trough of the dye solution or, by another plan, the goods are oscillated through the dye vat so that every fibre is saturated thoroughly. The reason for careful dyeing is that in case the pyroxylin film should wear off, the base goods so exposed will show the same coloring. After dyeing, the material is dried over a series of steam-heated cylinders and it finally passes through a 60-foot drying chamber, to be reeled up.

FROM here the material goes to the napping machines where some grades are prepared for household use, upholstery, et cetera. Napping is done by passing the material over rolls that look like giant cylinders of steel wool; each roll contains thousands of flexible steel points, rotating in opposite directions. These lightly touch one side of the passing cotton, fluffing it into a soft napped effect.

Color in the coating is, of course, a very important consideration. A hand coated sample is first prepared; with this as a guide, colors are blended in the mixers with the basic coating compound. Once approved by the head of the color room, the formula is given to expert mixers and great churns are loaded with sufficient compound to complete the job in hand.

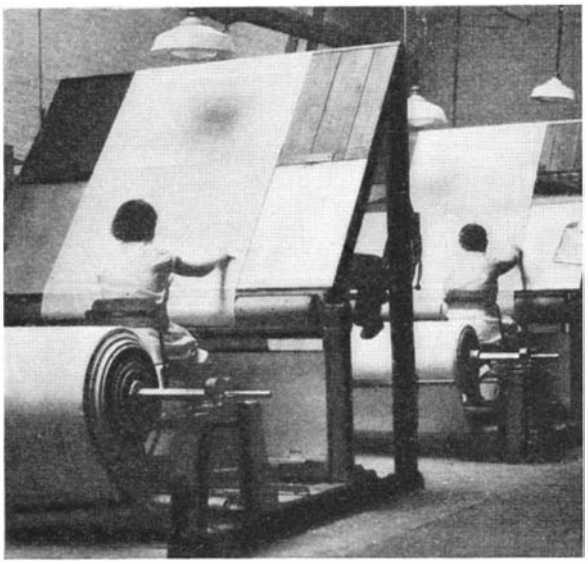
Coating is perhaps the most important single operation in the manufacture of Fabrikoid. The coating compound is applied in very thin coats by closely set knives—time after time—until the desired thickness has been obtained. Another inspection catches faults which, being covered, might pass the final physical inspection before the embossing operation.

In the embossing processes, the lacquered fabric is impressed with special designs which simulate any grain effect desired, and which remain for the life of the fabric.

After embossing, Spanish effects and multi-toning are produced by a finishing process in which a top coat of a special composition is put on the material and then scraped off. The new color remains only in the "valleys" formed by the embossing process.

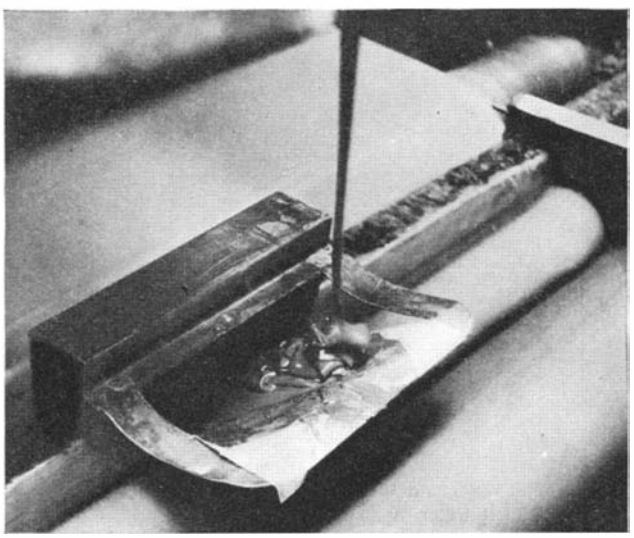
A final inspection on both sides maintains uniformity in color, grain, and finish. The inspection is made under nearly perfect lighting conditions, so that the customer may be sure of getting an article which is as perfect as it is humanly possible to make.

BEHIND all these processes of manufacture are the chemical and physical tests. These include chemical analysis, optical analysis, tests of strength of materials, submission of samples to fader-meter test, heat, humidity, and so on. The scrub test determines the resistance of the material to scuffing and flexing. The "exudation" test assures that there will be no chemical change in tropical countries. There are also abrading tests, fold tests, seat flexing tests, cold crack tests, aging tests and, finally, exposure tests. Certainly the E. I. du Pont de Nemours & Co. Inc. can never be taxed with being careless in testing this product.



Before the woven cotton base is dyed and coated, it is picked silk-smooth under the vigilant eyes and skilled hands of highly trained operators who examine both sides for minor imperfections of all kinds

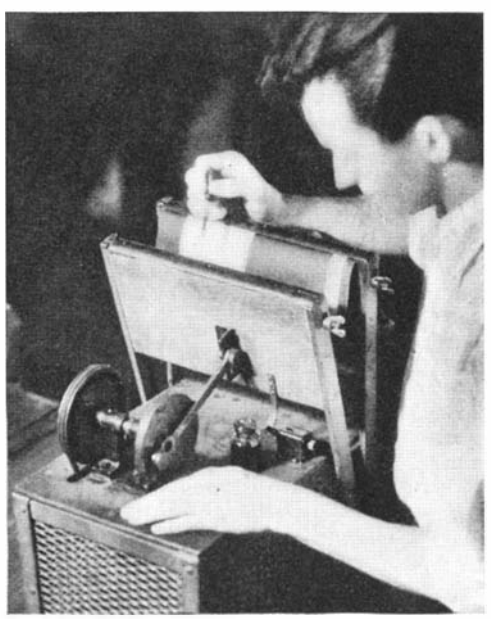
Here the varied elements of the finished coating composition are mixed into one. In the files in this room are formulas for 12,000 colors and shades, all properly classified and indexed. Shadings so subtle that the untrained eye could not identify them are cross-indexed so the key can be found when called for by a manufacturer. A trial batch of the color is made up by hand and is then matched up against the factory mixture which is loaded in great churns or mixers



The coating compound, carefully matched with sample as to color, and the base cotton fabric meet at the head of a coating machine where a "doctor" knife distributes the compound in very thin coats—coat upon coat—until the dyed goods have received a coating of the requisite thickness. This is essential to obtain a film of good quality and greatest anchorage. In some cases as many as 30 coats are required

Left: Since Fabrikoid is subject to much scuffing and rubbing when used for book covers, upholstery, cushions, luggage, and so on, the "abrader" tester was developed for making specific tests; it determines the resistance of the coated fabric to abrasion, testing both the film and the color

Right: This fold tester determines the probable life of the fabric, making a searching test for cracking under flexing. For medium grades, a test of 1000 folds under 10 pounds pressure is treatment usually given



THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

Contributing Editors

ALEXANDER KLEMIN
In charge, Daniel Guggenheim School of Aeronautics, New York University

A. E. BUCHANAN, Jr.
Lehigh University

Misconceptions on Ramie Fiber

RAMIE fiber has been in the news so much recently in connection with certain would-be economic discussions that a clearing up of some of the false impressions concerning it is fitting.

First of all, ramie fiber is not new, as some glib talkers would have us believe, by inference at least. It is said to have been one of the principal fibers used in China for making cloth previous to the introduction of cotton into that country about 1300 A.D. It is cultivated commercially only in China and Japan, although it has been grown in other countries for experimental purposes. All the work of propagation, cultivation, harvesting, and preparation of the fiber is done by hand. It is not readily spun on spinning machines designed for other fibers. Importations of ramie into this country are small.

A branch of the ramie plant showing the distinctive leaf and the fruit

Ramie yarns produced in the United States, England, and France have been used chiefly in the manufacture of incandescent gas mantles. A wide variety of woven fabrics are made by a factory at Emmendingen, Germany. Tablecloths, napkins, plushes, covering for upholstered furniture, curtains, carpets, dress goods, and knit goods are made of ramie fiber. In China this fiber is used for various fabrics similar to our linens, and especially for fishing lines, laces, mosquito nets, summer clothing, and grass cloth of various kinds. The Swatow grass cloth, used in embroidery or drawnwork doilies, table covers, and the like, is probably better known in America than any other ramie fabric made in China.

The areas in the United States where ramie could be grown are generally limited to the warmer Gulf Coast. Ramie must have abundant rainfall, but will not thrive in swampy land. It can not survive if the roots freeze in winter. Much American cotton is grown on comparatively dry land, and much of it where there is frost in the winter. This land could not grow ramie successfully.

Mechanical harvesting is impractical so far. In any climate humid enough to give a good growth, the ramie will mold if cut and bound in bundles. Therefore it has to be spread out or kept so air can get to it to dry it.

The fiber is strong on a straight pull, but can not stand twisting. It is good for use in salt water, as in fish nets.

Practically no experiments have been made with converting ramie into paper.

New Fertilizer from Peat

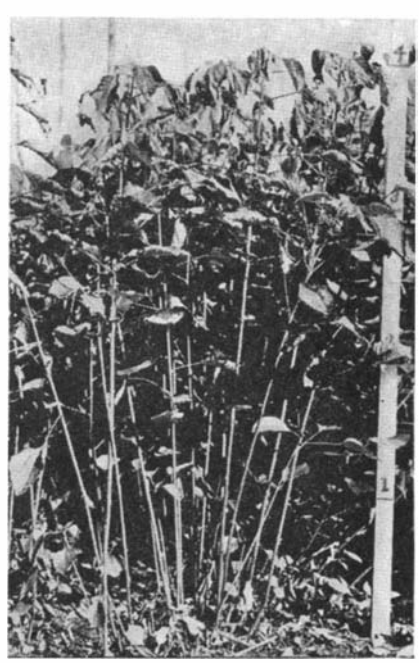
AMMONIATED peat, a new fertilizer material, has been developed in the laboratories of the United States Department of Agriculture. It seems to combine many of the good features of the two familiar types of nitrogen-carrying fertilizers. It has not been developed commercially yet, but chemists of the department say that the manufacturing process is simple and relatively inexpensive and that the commercial production of ammoniated peat offers opportunity for material saving in freight on fertilizers. Small-scale experiments with plants have given promising results.

By heating ammonia and peat under pressure, about two thirds of the reacting ammonia is changed to chemical combinations that are not soluble in water. These forms are generally similar to the nitrogenous fertilizer materials in cottonseed meal and animal tankage. Roughly, a third of the ammonia remains in water-soluble forms. Depending on temperature, the peat may be ammoniated so that it will consist of as much as 20 percent of nitrogen. A 20 percent product would thus contain in each 100 pounds nearly half as much quick-acting nitrogen as 100 pounds of sodium nitrate and at the same time would contain about twice as much slower-acting nitrogen as 100 pounds of cottonseed meal. In other words, 100 pounds of 20 percent ammoniated peat would be roughly equivalent to 200 pounds of cottonseed meal, plus 50 pounds of sodium nitrate.

Raw peat is of relatively little value as a nutritive ingredient in fertilizer, but is recognized as a highly desirable element in mixed fertilizers because of its value as a conditioner, preventing the caking of the product, and because it supplies to the soil a desirable form of organic matter.–*A. E. B.*

Yeast Testimonials Condemned

MEMBERS of the Vienna medical faculty who have given medical testimonials in favor of yeast have been "officially sharply reproved by the dean," that official, Prof. Dr. Ernst Pick, has just in-



Ramie plants four feet high. The fiber is obtained by stripping off the bark and then decorticating it

formed the American Medical Association. All members of the faculty were forbidden to give any testimonials intended for advertising purposes in the future.

The statement to the American Medical Association was signed by both Prof. Dr. Pick, dean of the medical faculty and director of the pharmacologic department, and by Prof. Dr. Roland Grassberger, former dean of the medical faculty and director of the hygienic department.

An investigation by the faculty showed that not a single member of the Board of Professors (heads of departments) of the medical faculty is involved in the yeast testimonials, and that the only ones concerned were seven privatdozents not included on the board, and not one of whom has the official position of teacher or is in charge of a department.

Privatdozents, according to the statutes of the universities of Austria, are not appointed by the state but are merely permitted by the state to teach, explains the American Medical Association.

The Vienna medical faculty statement contended that the testimonials favoring yeast were "spread and misused for advertising in American illustrated and other magazines in quack-fashion."

The medical faculty is concerned lest, through the impropriety of these advertisements, the reputation and esteem of the Vienna Medical School be seriously affected among the medical profession and people in America, and requested the American Medical Association to spread the explanation of the situation among its members and also publicly.—*Science Service.*

Paint in the Stratosphere

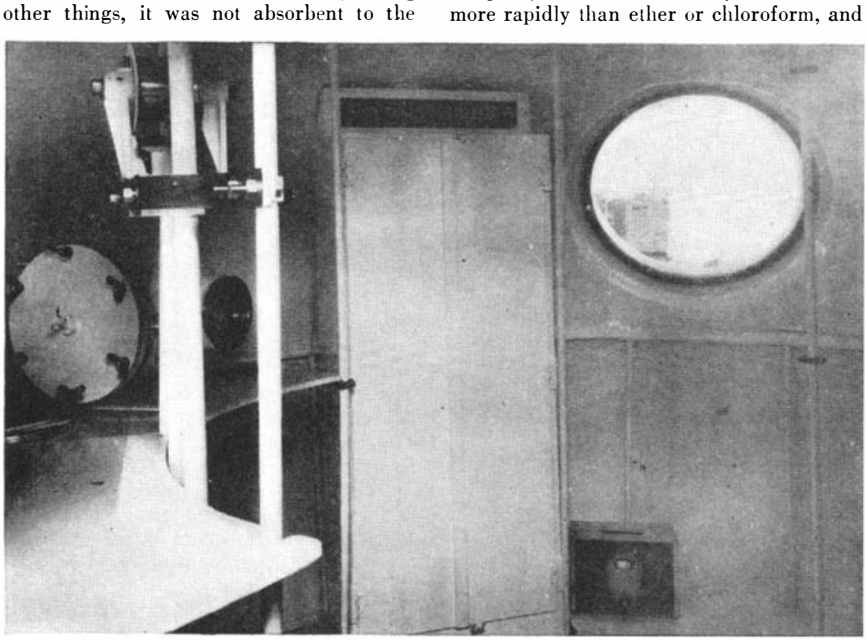
PROFESSOR AUGUSTE PICCARD, famous for his ascent into the stratosphere, used an American-made finish on the cabin of his balloon on the recent ascension because it fulfilled the special requirements demanded for the scientific voyage. This finish is known as Dulux and has been recently developed by E. I. du Pont de Nemours and Co., Inc. It is made on an entirely new formula with a synthetic resin base and was chosen because, among other things, it was not absorbent to the sun's rays and, therefore, would prevent the creation of heat in the cabin. A further point was that luminosity due to reflected light was necessary for the interior of the cabin due to the reduced dimensions of the portholes. The finish was used on both the inside and the outside of the cabin. Professor Piccard, after the ascension, reported that the product was successful for all the objectives intended. He stated as follows:

(1) We had good luminosity during the ascension in the interior of the cabin.

(2) The adherence of Dulux to the aluminum was perfect, the enamel forming one body with the metal.

(3) The reflection of the heat-bearing rays of the sun was such that during this second ascension we suffered from cold. During the second trip the temperature in the interior of the cabin was 40 degrees Centigrade (72 degrees Fahrenheit) lower than it had been during the first trip.

(4) On landing and in the subsequent transport of the cabin it was dragged over a granite-like earth and as a result sustained a number of dents and scratches on its exterior. However the Dulux did not in any way chip off. It was carried away in places with the upper layer of the aluminum just as if it had made one body with it.

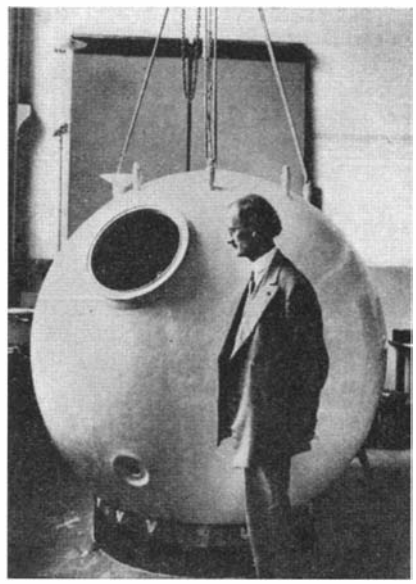


Interior of the "cabin" of Professor Piccard's stratosphere balloon

Synthetic Quinine and a New Anesthetic

TWO important chemical discoveries in the field of medicine are reported in a recent issue of *Industrial and Engineering Chemistry*. From the University College of Science in Calcutta comes the report of a synthetic quinine which possesses the same antiparasitic value as the natural product but is considerably less bitter. Full information is yet lacking but the synthetic material is reported, on the basis of preliminary experiments, to be probably more useful than naturally occurring quinine.

At the University of California Medical School, experiments in the use of divinyl oxide show it to be a rapid and efficient general anesthetic. The report of this work, confirmed in the University of California Hospital, states that divinyl oxide acts more rapidly than ether or chloroform, and is more rapidly voided from the system than ether, with less excitement and nausea to the patient. Through its use there is less irritation of the lungs, less disturbance of the heart, and less change of the body's chemical equilibrium than with older anesthetics.—*A. E. B.*



Professor Piccard standing beside the spherical gondola of his balloon

Materials in Radio

THE strikingly large quantity and variety of materials which are used by the American radio industry is revealed in a statistical report compiled by the United States Department of Commerce. Steel, in strips and bars, leads the metals in quantity, totaling 110,000 tons a year. Copper, in sheets and as wire, follows with 12,000 tons, with copper alloys accounting for 4000 tons more. Tin in foil form and tinplate aggregates 1800 tons. Nickel alloys, used in tubes, amounts to 1500 tons, and zinc totals 1200 tons.

Valuable Insecticide Found in Weed

"THE Devil's Shoestring," also known as the wild pea, a common weed in the eastern half of the United States, contains rotenone, a valuable insecticide, a United States Department of Agriculture chemist has found. The discovery is significant for farmers, both as potential growers of the plant and as users of the insecticide, to insecticide manufacturers, and to importers who carry on international trade in rotenone and other commercial insecticides.

W. W. Skinner, assistant chief of the Chemical and Technological Research Unit of the Bureau of Chemistry and Soils, first called attention to the probable insecticidal value of devil's shoestring, following his observation that bees and other insects fed on nearby plants but avoided the blooms of this toxic weed. Doctor Skinner later instigated the research which led to the recent discovery of this weed's rotenone content by E. P. Clark of the bureau's Insecticide Division.

Rotenone, which is used for the same purposes as pyrethrum and nicotine insecticides, has been extracted chiefly from

derris, a vine from the East Indies and from the root of the cube, a South American shrub. It is deadly to many insects, but it does not poison man or animals.

The devil's shoestring, *Cracca virginiana*, is the first North American plant found to contain rotenone. Related species are found in tropical countries. The discovery of rotenone in this American plant promises to make the United States independent of foreign sources for insecticides made from rotenone.

The rotenone is found chiefly in the root of the plant. Rotenone and other constituents of an insecticidal nature make up 4 or 5 percent of the roots. Department scientists believe this could be increased by selection and breeding. Rotenone now costs about the same as the pyrethrins, the active principles of pyrethrum flowers, but the department scientists believe that as its use increases it will become cheaper. It is rapidly coming into use in greenhouses, for truck crops, and for combating fleas and other external parasites on animals. Spray material, containing about 5 percent rotenone, has recently sold for about 10 dollars a gallon. A gallon of this material is diluted to make about 800 gallons of spray.—*A. E. B.*

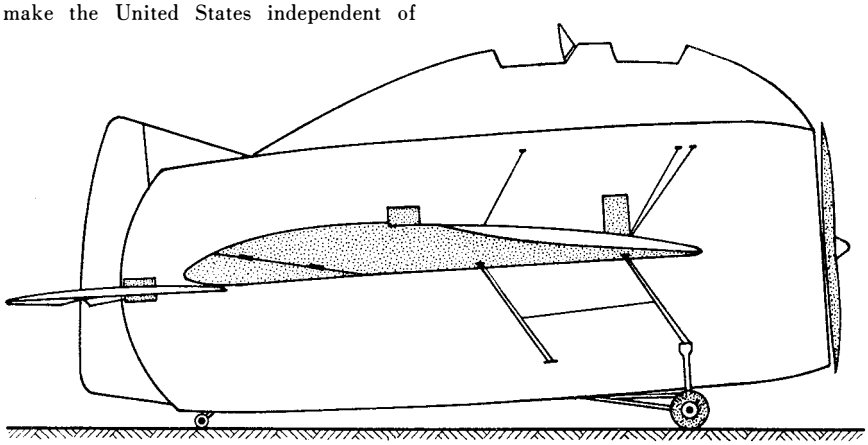
A Flying Venturi

ENGINEER Stipa of the well known Caproni factory in Italy has recently built and flown a curious type of craft which has been termed a "Flying Venturi."

The engine, as shown in our sketches, is placed inside a huge tube; the propeller is at one end; to the sides of the tube are attached the wings and tail surfaces; the pilot is seated in a humplike structure on top of the tube. The experimental machine has a gross weight of 1763 pounds, a span of 47 feet, a horsepower of 120, and a wing area of 205 square feet.

English critics are apt to treat this machine rather flippantly. A facetious writer in *Flight* fears that small boys may easily stow away in the Venturi without the pilot knowing it. "They would have a slightly uncomfortable time, but then what boy minds that?"

French and Italian writers are more friendly to the idea. It is perfectly true that owing to the inner air passage the skin friction will be increased. But on the other hand, as the section of the tube increases behind the propeller and the air flow slows down, the pressure of the air increases and this pressure will have a forward component of action on the tube. In other words, the energy losses behind the propeller may be recuperated to some extent. Wind tunnel experiments have indicated that these theories are worth serious consideration.

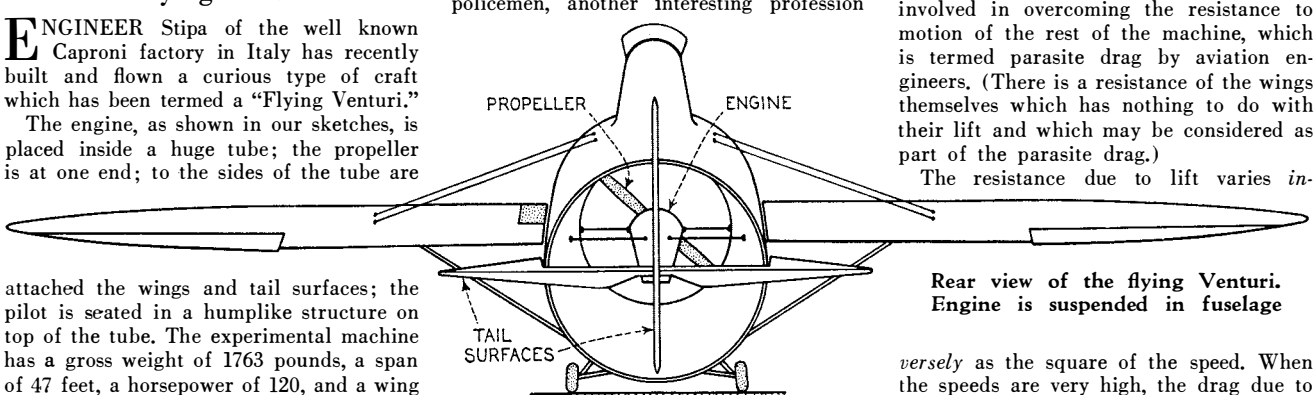


Side view of the flying Venturi, illustrating details described in article

Signor Stipa considers his present machine to be purely an experiment and is of the opinion that his system will have a much better chance of success in very large aircraft. In a very large machine, the tube would be proportionately much smaller. A number of such propellers with their engines would then be mounted inside a cantilever wing. On a large scale, the Venturi propeller system looks even more plausible. There is really not enough basic aerodynamic data available as yet to pass definite judgment.—*A. K.*

The Airway Patrol

A NUMBER of large American cities have endeavored to establish aviation police, but none of these efforts have developed very far. Flying traffic is not as yet extensive enough to justify policing of the air. But while there are very few aerial policemen, another interesting profession has opened up to the experienced flyer: that of Airway Patrol Pilot.



Rear view of the flying Venturi. Engine is suspended in fuselage

The Department of Commerce is constantly improving and increasing its aids to navigation over the federal airway system. These aids must be periodically checked up for performance and effectiveness by the patrol pilots now assigned to such duty. The patrols check relative brightness and elevations of beacon light beams; the orientation of radio range courses and the transmission of proper signals; the correctness of speech and transmission of weather broadcasts; the condition and facilities of intermediate landing fields.

The patrol planes are fully equipped for night flying and for radio receiving and transmitting. Perhaps the most important task in night patrol is inspection of the beacon lights. The patrol pilot notes first whether each light is visible at the distance from which it is normally possible to observe these powerful searchlights. Under conditions of good visibility the rotating airways beacon should be seen at least 30 miles away. If the beacon can not be seen at the usual limit of its range, it may be that the beam is not adjusted to the correct elevation and this has to be corrected immediately. If the beacon is dark, a patrol pilot takes steps immediately to have it put back into operation. These and other duties have to be carried out winter and summer. Regular log books are kept and reports are frequently sent to Washington.

The Department is to be heartily congratulated on the establishment of this Airway Patrol, the only one in existence the world over.—*A. K.*

Superaviation

A CLASS discussion at the California Institute of Technology has aroused much interest and from reports in the press, one might gather that flying at 1000 miles per hour is imminent. The discussion was based on a paper by the Italian scientist, General G. A. Crocco, read by him before the Italian Association for the Advancement of Science in September, 1931. Little has been added to the General's statement of his theories, and Italian is not a language which Americans deal with readily. It is not out of place, therefore, to discuss what General Crocco meant by *Superaviation*—the term which he used to denote flight in the stratosphere at speeds above that of sound.

The air resistance or drag in flying may be divided into two parts: 1—That involved in producing the lift of the wings. 2—That involved in overcoming the resistance to motion of the rest of the machine, which is termed parasite drag by aviation engineers. (There is a resistance of the wings themselves which has nothing to do with their lift and which may be considered as part of the parasite drag.)

The resistance due to lift varies *inversely* as the square of the speed. When the speeds are very high, the drag due to lift becomes negligibly small.

The parasite resistance, on the other hand, varies as the density and *directly* as the square of the speed.

If we could fly at 500 or 600 miles per hour at sea level, the resistance due to lift would be negligible as previously stated. But the parasite resistance would become enormous, and the horsepower required prohibitive. The way to get around this prohibitive parasite drag and horsepower is evidently to fly at very high altitudes where the density of the air is very low, and the

parasite drag is decreased in proportion.

Based on this theoretical but quite definite advantage, attempts are being made to fly in the stratosphere. But the advantages of stratosphere flying can only be attained when the power of the engine is maintained at altitude. This is done by supercharging which means compressing the air back to sea-level conditions before admitting it to the carbureter. (See also "The Truth About High-Altitude Flight," March and this issue of SCIENTIFIC AMERICAN. *Ed.*)

General Crocco, following the thoughts of many distinguished men, suggests that for superaviation the internal combustion engine must be replaced by a totally different type of prime mover, namely the jet propulsion engine. The jet propulsion engine is of course akin to the rocket motor, and many pioneers consider that the rocket motor is in itself the solution of superaviation.

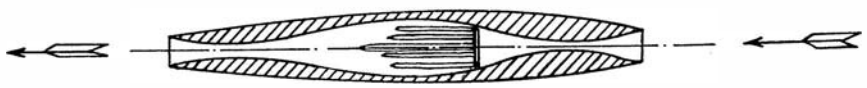
Reduced to its elementals, the rocket motor is a mechanism whereby liquid oxygen is suitably fed into a combustion chamber into which gasoline or a similar fuel is also introduced. The mixture is ignited, and the resultant gas mixture, at high temperature and pressure, flows with great rapidity through a suitably shaped orifice. As the gas passes out into the atmosphere its great speed causes a powerful reaction on the motor, which, in turn, drives the aircraft through the thin air.

Crocco, however, considers that the rocket motor is *not* the solution of the propulsion problem at high altitudes in spite of its apparent simplicity.

The rocket motor has to carry its own supply of oxygen, and the amount of oxygen required for the combustion of gasoline is roughly six times the weight of the fuel. Hence long flights will involve prohibitive amounts of liquid oxygen.

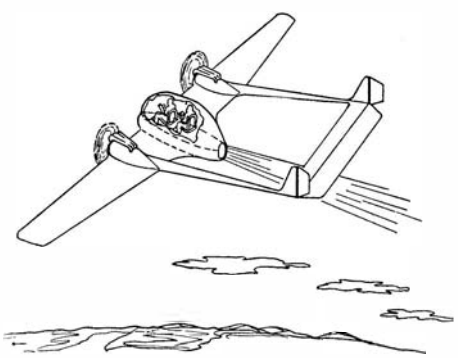
The General revives a suggestion of René Lorin, a Frenchman, who in 1913 suggested the simple mechanism illustrated in the diagram. The Lorin engine would take in the oncoming air, perhaps at a speed of 1500 feet a second or more (in the superaviation of the future) through the front opening. The air would be highly compressed on entrance into the engine because of its great speed. Its temperature would rise at the same time. Mixing with the gasoline at "auto-ignition" temperature, there would be combustion, a great increase in temperature and pressure, and a rush out at the rear of the engine at even greater speed than that of the aircraft as a whole. The Lorin type of engine would not need the heavy and awkward supply of liquid oxygen; it would be automatic and very simple.

Granted that the Lorin nozzle is indeed the power plant for superaviation, there still remains a serious difficulty. Jet propulsion motors become efficient only when the speed of the exhaust gases issuing from the rear of the engine is not too greatly in excess of the speed of the flying machine. At high altitudes and at speeds of 1000 miles per hour, Lorin's mechanism can probably be made to give just as high an efficiency as the present day combination of propeller and internal combustion engine.



Lorin's jet propulsion engine. Arrows show direction of air movement

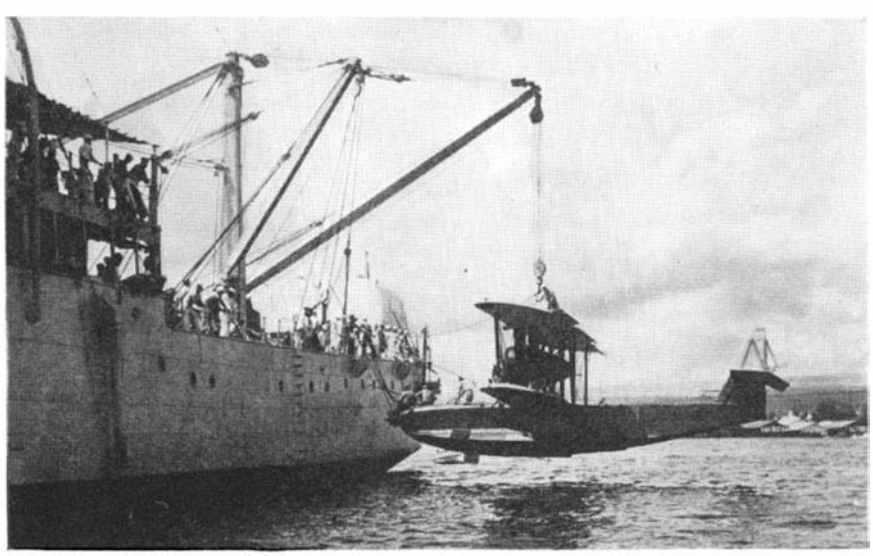
But at the beginning of a journey when near sea level, the flying machine speeds are low and the jet engine is woefully inefficient. Therefore there must be at starting some auxiliary power plant to get the plane up to the great heights. Professor Goddard suggested that the exhaust gases of the rocket motor should work on a gas turbine which in turn would drive an ordinary propeller. Then when sufficient altitude had been reached the propellers would be swung out of the gas stream and the jet reaction system would come into play. (See March, 1932, SCIENTIFIC AMERICAN. *Ed.*)



Combined rocket and supercharged engine airplane. This would seem the best type for stratosphere flying

The other suggestion is that a conventional supercharged power plant and propeller would be used until an altitude of some 15 or 20 miles above the earth's surface had been reached. The Lorin engine would then be brought into play.

Needless to say, every one of these plans is full of difficulties and complications. The problem of the jet engine itself on the Lorin principle is sufficient to provide some real work for research men for ten years. The transition from supercharged flight to jet reaction flight is another nut to crack. Superaviation will probably only come after years of experimentation by engineers, chemists, inventors, and designers.—*A. K.*



U. S. Navy, Official photograph

Hoisting a seaplane aboard U. S. S. *Ogalala*, at Hilo, Hawaii

Taking a Flying Boat on Board

THE process of taking a flying boat of large dimensions on board a naval vessel is quite complicated. Hoist and tackle, masts and jibs are brought into play, with plenty of well trained bluejackets to assist in the task. The entire weight of the flying boat is suspended from two points on the upper wing, and the wing has to be designed very carefully to withstand this concentrated load.

In our photograph is shown a Keystone Patrol (equipped with two Wright 575 horsepower engines) being hoisted aboard ship in a dead calm. When there is wind and rough sea, the difficulties may be very great. The surface vessel may roll or pitch one way; the flying boat with its huge wing-spread may be buffeted by the wind in some other direction.

This partially explains why the United States Navy employs so many land planes for its observation work. The land plane is less cumbersome, can be more readily catapulted, and has more speed than the flying boat. When its fuel is exhausted it can alight only on land or on the deck of an aircraft carrier. The flying boat can not alight on the aircraft carrier, and if it lands in the water, it may be impossible or dangerous to hoist it on board. Therefore the land plane may be a better service type for many purposes than the flying boat one would expect the Navy to use.—*A. K.*

Night Winds Forecast by Lighted Balloons

SMALL, free balloons carrying little paper lanterns or tiny electric lights up through the air make possible night-time forecasts of the velocity and direction of the wind at different atmospheric levels. The electric lights, which are heavier and more expensive than the candle-lighted lanterns, are used only where there is danger that forest fires might be started by the lanterns, which sometimes burst into flames. Meteorologists attached to the airways weather service maintained by the Department of Agriculture in co-operation with the Department of Commerce can follow the gleam of the illuminated pilot

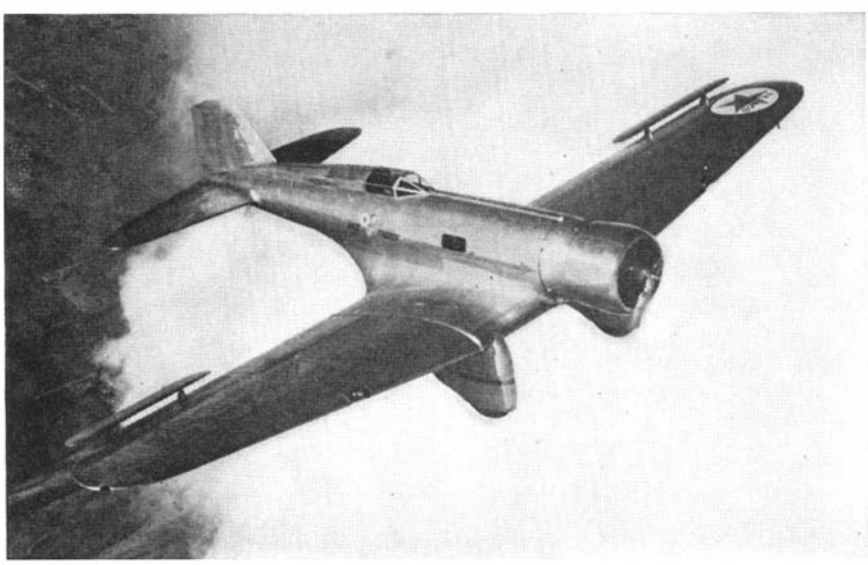
balloons after dark as easily as they can watch the unlighted balloons by day.

Each pilot balloon, about 30 inches in diameter, is filled with just enough hydrogen to insure ascension at a uniform rate of 600 feet a minute. The ascent is carefully timed and watched through a theodolite, an instrument something like a surveyor's transit, on which angular readings of the balloon's position are made at one-minute intervals. From the readings thus obtained meteorologists compute the balloon's direction and speed of travel for each minute of flight. This reveals the velocity and direction of air currents.

Continuing the pilot balloon runs by night, which for some time have been made at scheduled intervals throughout the day, gives nocturnal fliers the guide they need for steering clear of air levels where dangerous head winds prevail and keeping in the levels of favorable following winds.

A Refined Design

THE indomitable Commander Frank M. Hawks, aviation advisor to the Texas Company, has fully recovered from his accident and is ready to seek new records with a wonderful new plane, the *Sky Chief*, built by the Northrop Corporation and equipped with the new Wright double-row engine of 14 air-cooled cylinders, which develops 700 horsepower.



A marvel of the air: Commander Hawks' new Northrop Texaco *Sky Chief*

The new plane is a marvel of structural and aerodynamic design. It weighs 3300 pounds empty, and 7100 pounds fully loaded. This means that the disposable load (fuel, oil, pilot, and so on) is actually 115 percent of the empty weight, a figure which is perhaps a record. Altogether, the *Sky Chief* will carry 616 gallons of gas. With a high speed of 245 miles per hour, the aircraft will provide a splendid tool for the research in high-altitude flying which Commander Hawks is undertaking.

As in all Northrop designs, the *Sky Chief* is of metal throughout, with metal covering, so that the outer surface of the plane is smooth and durable.

By dint of much wind-tunnel research, by filleting the wings carefully into the body, the air drag has been reduced to a minimum. The air resistance of the entire plane with its wing area of 365 square feet is equivalent to only six square feet of flat plate held perpendicular to the wind.

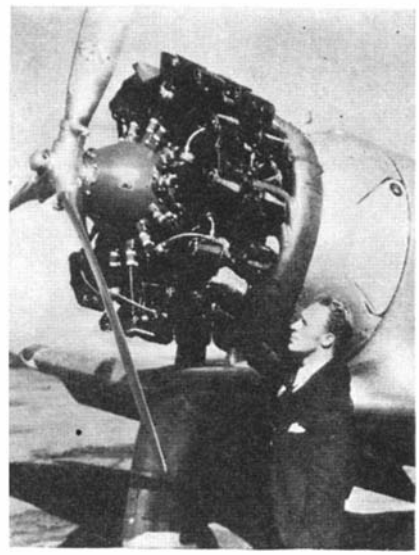
Although the loading in pounds per square foot of wing area (that is, gross weight of 7100 pounds divided by 365 square feet of area) is approximately 19.5 pounds, the landing speed is only 54 miles per hour. This low landing speed is achieved by the use of a special form of split flap which increases the maximum lift capacity of the wing 38 percent and hence lowers the landing speed appreciably.

Everyone is now familiar with the use of ailerons placed towards the tips of the wings for purposes of lateral control. But if there is a special flap of this type, there is no room for the ailerons. That is why small movable surfaces are placed above the wing as shown in our photograph. By moving these surfaces in opposite directions, the lateral control is quite as good as with the conventional aileron.—*A. K.*

Protection Against Antarctic Storms

A PLANE similar to the *Sky Chief* of Commander Hawks is to be used by Lincoln Ellsworth for his 1933 trans-antarctic explorations. A serious difficulty in such work is to guard the plane against sudden storms. It will be remembered that the Byrd expedition lost a high-wing plane in the Antarctic in a particularly violent blizzard.

With a low-wing monoplane the danger in a blizzard is diminished and Ellsworth has in mind the following useful dodge: The airplane will be provided with skis for snow flying. A couple of trenches are dug into the snow in which the skis are run. The wing is then snug near the ground, and the airplane can successfully defy the fury of the storm.—*A. K.*



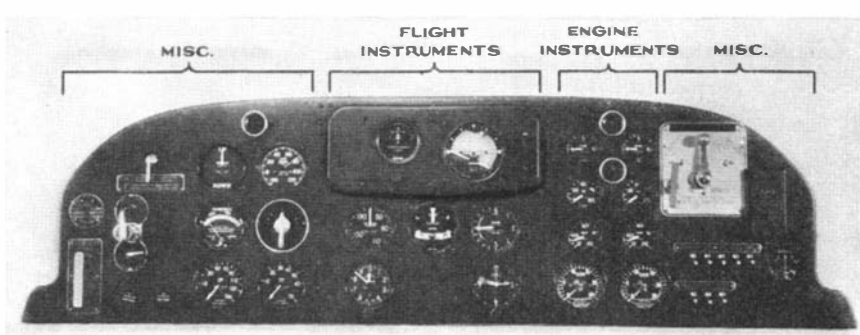
Commander Hawks examines the *Sky Chief's* 14-cylinder Whirlwind

The Pilot's Second Set of Senses

THE new low-wing, all-metal, twin-engine Boeing transport plane is rapidly nearing completion. The new machine will be one of the fastest if not *the* fastest multi-motored planes in the world. The new design involves many novel features and the very latest practice. A striking idea of the complexity and completeness of the instrument panel on a modern transport ship is given by one of our photographs. Flight instruments, the pilot's second set of senses, are naturally placed in the center of the instrument panel. These include: directional gyro; artificial horizon; air speed indicator; a turn and bank indicator; a rate of climb indicator; and a clock.

The engine instruments are grouped somewhat to the right. Since two engines are employed, all engine instruments are in duplicate, and thus we find, from top to bottom: 2 fuel pressure gages; 2 oil pressure gages; 2 oil temperature gages; and 2 electric tachometers.

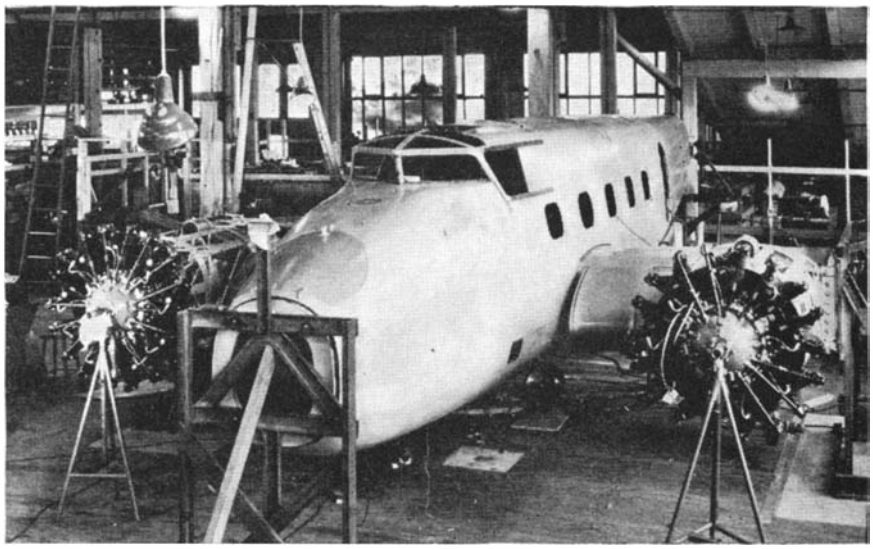
To the left of the flying instruments is a miscellaneous group. This includes a landing-gear position indicator warning the pilot that he must let down his retractible landing gear before setting down his plane; outside air temperature gage; cylinder temperature gage; and fuel gages. On the extreme right are a primer, a parking brake lever, switches, and so on. The compass is not shown but is located in the "vee" of the windshield.



Complexity and completeness of the instrument board on a modern transport

Our readers may be curious as to how an airplane shop looks when a plane is nearing completion. Another photograph shows the center section of the Boeing plane with the two engines mounted at the leading edge of the wing. When everything appears to have been finished on the airplane, the correct installation of the power plant, the adjustment of the many lines and engine instruments can give the constructor endless trouble!

The beautiful balanced lines of the modern airplane do not just happen. They are the result of endless study on the drafting board, by clay modeling, and by wind-tunnel testing. A third photograph shows a master layout in wood representing one side of the Boeing transport fuselage. This master layout in wood requires all the infinite care that is taken in laying out a racing yacht hull.—*A. K.*



A Boeing multi-motored plane nearing completion, with two engines installed

Searchlight Efficiency

SOME two years ago a new searchlight made its appearance on the market. It gave much better performance than those of previous design and at the same time was much smaller and more compact. At that time a searchlight less than 18 inches in diameter, using ordinary incandescent lamps and giving a beam candlepower of 1,840,000 was an "impossibility," but it was produced in 16-inch diameter.

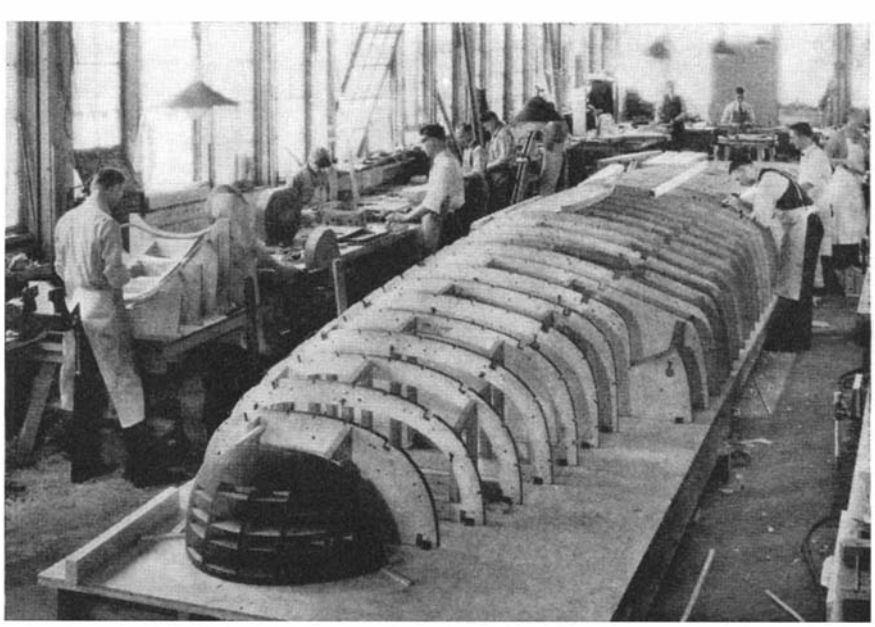
Just to make matters more interesting, a lamp that consumed only 240 watts was used, while all other units in use at that time were using lamps that consumed 1000 watts or more to obtain lesser results. It opened up new fields for incandescent searchlights.

It was found that this new searchlight would project sufficient light to read a newspaper at a distance of five miles. Airplane pilots reported that they could see its beam nearly one hundred miles. Military organizations mounted these searchlights on airplanes and found that they had much greater range than anything that they had tried before. Still the engineers were not satisfied, so they improved the unit.

Recent tests on the improved units show that the beam candle-power has been increased to over three million, a gain of more than 60 percent. This searchlight is still a 16-inch unit using a 240-watt lamp. The system of mirrors and lenses, however, has now been improved to the limit possible with existing machinery for the manufacture of these optical parts.

The optical system now employed consists of three parts: A primary reflector of silvered glass, accurately formed to a curvature known as a modified parabola of rotation, then highly polished; a secondary reflector of silvered glass, ground and polished to a form which redirects into the main beam most of the light which would ordinarily be lost; a front lens of ground and polished clear glass, having wires of a special alloy fused into it for additional strength and safety, providing maximum protection for the costly reflectors. A special alloy was used for these wires in order to obtain a nearly perfect bond between the metal and glass, thereby assuring that no distortion of the beam would result due to slight changes in glass density immediately adjacent to the wires.

This improved searchlight, using an incandescent lamp, now offers practically the same visibility of range as the usual type of high intensity searchlight using a luminous arc as a light source. As the initial cost of an incandescent searchlight, cost of operation, and cost of maintenance are much less than the arc type searchlight, this means that the incandescent lamp, due to the ingenuity and perseverance of Westinghouse engineers, has successfully invaded a new field.



A master layout in wood representing the side of a transport fuselage

Odorless Asphalt

INDUSTRIAL adoption of a new method of manufacturing asphalt emulsions devised at Columbia University will banish the smoky, smelly "tar-pots" used in road repairing, according to a report of Professor A. W. Hixson and J. M. Fain. Asphalt emulsions now in use have failed to replace hot asphalt in road repairing, roofing, and similar applications, because of their tendency to break down, giving a surface which is not waterproof, but the new emulsion is said to be as efficient as the hot liquid asphalt and far easier to apply. It can be spread with a paint brush or a trowel, or it can be squirted on a surface with a paint or cement gun.—*A. E. B.*

Pharaohs Knew Alloys

EVEN the ancient Egyptians learned to make and to use alloys, according to an article in the *Chemiker Zeitung* (Germany) dealing with the chemical composition of prehistoric bronzes.

Up to about 4000 B.C., an analysis of 29 objects of Egyptian origin shows, fairly pure copper was used. Bronzes began to be used from about 1200 B.C. on. The objects examined contained from 57 to 100 percent copper, with small quantities of iron, zinc, nickel, arsenic, tin, silver, and bismuth.

Impairing Health by Excessive Caution

HEALTH faddists belong to that minority of persons who naturally become excessively enthusiastic about something because it is new, says Dr. Theodore B. Appel, Secretary of Health, Commonwealth of Pennsylvania, writing in the *United States Daily*. They are likely to be influenced by the gloss rather than by the heart of the matter. They are "in

the mode," which, after all, is often their main concern.

Such persons fall for all sorts of ideas, some of them good, others only half good, many of no value, and others of decided harm. It is quite impossible to control persons of this type, for by their very nature they are quite uncontrollable. So, if they make a mess of things, it is their own fault.

But there is another class who are really sincere about health and long life, who overdo the thing. And advice can help such persons.

A well-meaning man recently came into a physician's office somewhat worried about his condition. The doctor, after questioning him, discovered that he religiously walked four miles a day, watched his diet like a detective, got his eight hours nightly sleep willy-nilly, drank no coffee or tea, used no tobacco, and in every other conceivable way seriously and conscientiously attempted to carry out the basic living rules.

But the sad fact remained that physical righteousness had not only gone to his head but to his body also. This individual had become so imbued with the religion of proper living that he unconsciously had become a fanatic, and in his fanaticism had become so violently earnest in well-being, that the thing back-fired upon him.

In short, he was a nervous wreck, which should at least prove that health fanaticism, whether directed toward fads or orthodox expressions, is neither good for the soul nor the body.

Persons, of course, should become interested in healthy living. And they should abide by the major rules of nature, and thus make a practical application of their interest. But when the zeal for health becomes an obsession, it is carrying the thing quite too far.

After all, the main object in life is to live. Most of the living should be a more or less automatic affair with the primary rule of moderation and good sense crowning all.

Goldenrod to Yield More Rubber

THE United States Department of Agriculture is trying to increase the amount of rubber in goldenrod.

Believing that goldenrod has possibilities as an emergency source of rubber for the nation, the department has planted several native species of the plant at its experimental station near Charleston, South Carolina, and will select and breed promising varieties. Rubber specialists of the department believe the rubber content of goldenrod may be increased just as the sugar content of sugar beets was increased by breeding and selection.

In the last two years the department analyzed more than 30 species of goldenrod gathered in the vicinity of Washington, D. C., and at Charleston, finding some in which the leaves, which contain most of the rubber in goldenrod, yielded as much as 7.91 percent rubber.

The Charleston plots have plants contributed by the Edison laboratories in Florida, plants collected in the vicinity of Charleston, and plants from Washington, D. C., and near-by regions.

Painless extraction with gas. Tungsten oxide is inserted into the flaming trough of a hydrogen furnace at the Westinghouse Lamp Company. Three hours of this and all moisture has been extracted, leaving powdered metal tungsten. This powder is placed in huge presses and pressed into solid metal for drawing into lamp filaments

Large Areas Revert to Forests in U. S.

THE area of forest land in the United States has increased about 33,000,000 acres, or more than 6 percent, since 1920, United States Forest Service estimates indicate. Reversion of cultivated and pasture lands to forest is largely responsible for the increase.

A recent study of existing information on forest areas places the commercial-forest area at 496,000,000 acres. Of this total, however, only about three eighths bears saw timber; one fourth bears trees of cordwood size, and the remaining three eighths varies from fully stocked areas of young growth to land practically bare.

Sixty million acres of forest land have been so denuded by lumbering and fire that they are not restocking naturally and will not again become productive without artificial assistance over a long period of years. Abandoned farms, reverted pastures, and cut-over forest lands on which owners have been unwilling or unable to pay taxes are accumulating much faster than the facilities for planting them to good tree stands. Most of this land has commercial timber potentialities, if good forest management and artificial planting can be supplied.

The estimate of commercial forest area does not include about 10,000,000 acres withdrawn from timber cutting for recreational and other public uses, nor does it include about 100,000,000 acres of low-grade woodland and scrub of little or no value for production of saw timber, although much of it is valuable for watershed protection.

How Big is a Bridge?

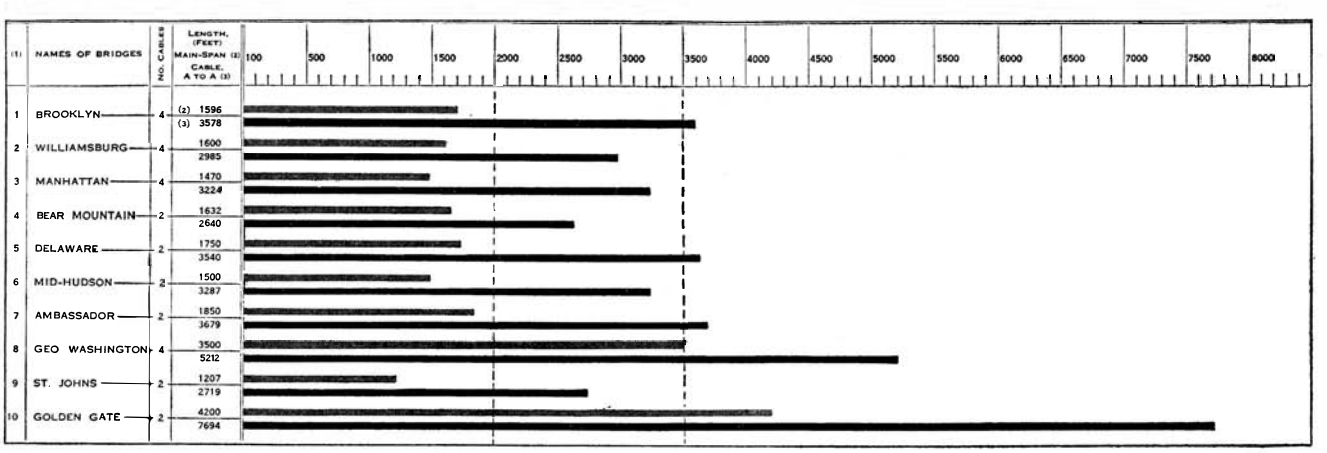
THE question "How big is a bridge?" is asked by *Wire Engineering*, a publication of the Roebling Company, and answered by the statement: "That depends on the 'measuring stick.' "

Some say the Golden Gate Bridge will be the biggest; others say the George Washington will still hold its first place in suspension bridges. For the third place, the Ambassador and the Delaware compete, while for the fourth place, the Delaware, Brooklyn, and Manhattan bridges are contestants.

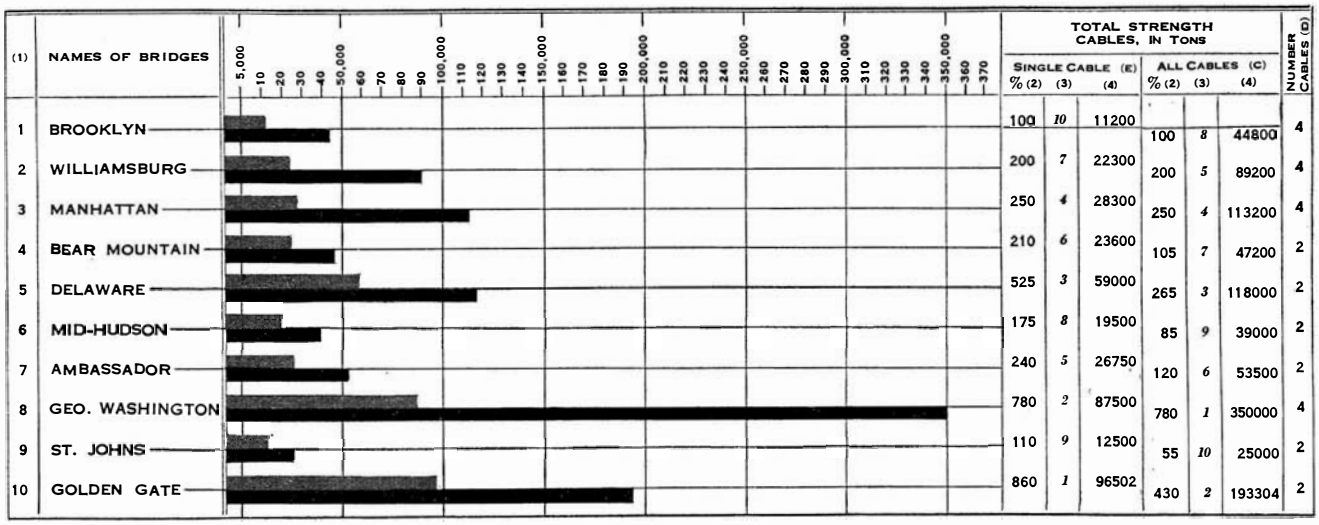
Bigness in suspension bridges, therefore, is a matter of the factors picked for the measuring.

Suspension bridges are "built-to-order"—built to meet local traffic conditions, present and future, and every such bridge is a designing and constructing problem unto itself, a problem for the traffic, bridge, and cable engineers, the geologist and financier.

With the historical Brooklyn bridge as a starting point in big suspension bridges, each bridge since then has been built big to meet some local traffic condition—bigger than the previously existing traffic-moving facilities, and a look into the future for



Comparing suspension bridges by length of main span and length of cable—bridges listed in order of erection. Top figure, and shaded line—length of main span in feet. Bottom figure, black line—cable length anchorage to anchorage



Strength of cables of suspension bridges. Top shaded line indicates strength of single cable (E) and black line, strength of all cables (C). Percentage of bigness and order of bigness (3) are given for single cable and all cables of each bridge

how much bigger to build to meet expected traffic requirements. But what is bigness in suspension bridges?

If we take the popular conception—length of span—as our measuring stick, the new Golden Gate Bridge (with its 4200-foot main span and its total length of each cable, 7694 feet, anchorage to anchorage) takes first place, as shown in an accompanying graph. To the cable manufacturer, this means a far different problem than a shorter main span with a heavier load to carry as is the case with the George Washington Bridge, in second place, (with a 3500-foot main span and 5212 feet as a cable length, anchorage to anchorage).

If we take diameter-of-cables as the unit of measurement of bigness, the Golden Gate, with its 36½-inch diameter cables as compared with the 36-inch diameter of the George Washington, is still the biggest.

Length of main span and diameter of cable are, however, only a part of the picture.

To express size in terms of "total-strength-of-cable" gives a more complete idea-picture in comparative bigness, for in such terminology is included the requirements not only of length but also of width, traffic requirements, and additional lanes or decks for future needs.

Consider, then, the most prominent elements of the George Washington Bridge—the four massive parallel wire cables, built for a total strength of 350,000 tons, or 87,500 tons per cable, to meet the heavy traffic demands of today. A study of the second graph enables us better to appreciate the size of these two great structures, and the relative position of the other eight in this group of big bridges. The ten bridges with cable strength of 25,000 tons and over have been selected for this comparison.

Bigness, it may be concluded, is best measured in "cable strength" whether we consider the total strength of the cables in the bridge as a unit or a single cable.

New Uses Wanted for Arsenic

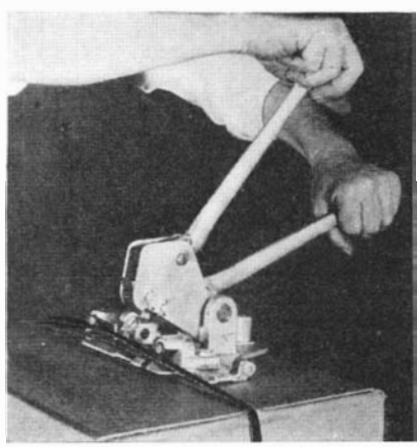
AT the recent annual meeting of a European ore-mining company, it was revealed that the potential output of arsenic in 1933 is 400,000 tons of ore. The ultimate destination of the enormous quantities of arsenic to be produced is a problem.

It is hoped that new uses for arsenic will be found which will make it possible for the company to dispose of their stocks on the world market. This being unsuccessful, arsenic will follow in the footsteps of mercury. In both cases there is an attractive opening for chemical invention.

At present arsenic is being used in medicinal preparations; in lead alloys for bullets and shots; pyrotechnic and boiler compositions; as a depilatory agent; manufacture of paint pigments, opal glass and enamels; textile dyeing; calico printing; bronzing agents or decolorizing agents for glass; for insecticides, vermin poisons, sheep dips, and so on.—*A. E. B.*

New Strapping Tool

A SINGLE tool for strapping boxes, packages, and the like, which incorporates stretching, sealing, and cutting mechanism is now being marketed by the Acme Steel Company, Chicago. This new



New combination strapping tool

tool, it is claimed, automatically assures a good strapping job. Strapping time is materially reduced because many motions formerly required of two and three tool systems are eliminated.

In operating the new combination tool, the seal is snapped into the mouth of the sealer and the band is inserted in the tool. Then comes a simple and efficient one-two action. One stroke of the stretcher lever tightens the band. One stroke of the sealer lever applies the seal, seals it, and cuts the band from the coil.

When the above operations are completed, the tool still retains the loose end of the band so that it will be right at hand for the next package.

Radium in Canada

THE discovery of large deposits of radium-bearing minerals in the Great Bear Lake district of Canada has led to the development of a more efficient method of extraction of the element from its ores. Announcements of this from Canadian official sources imply that the quantities of radium thus made available are comparable with those from the Belgian Congo which now produces practically all the world's radium. It is expected that the efficiency of production by the new process will make Canadian radium an important factor in the market. Commercial operation is not yet fully under way.—*A. E. B.*

A Roof That Could Last Three Centuries

THE Pennsylvania Terminal in New York has a roof which metallurgists estimate can last for 300 years.

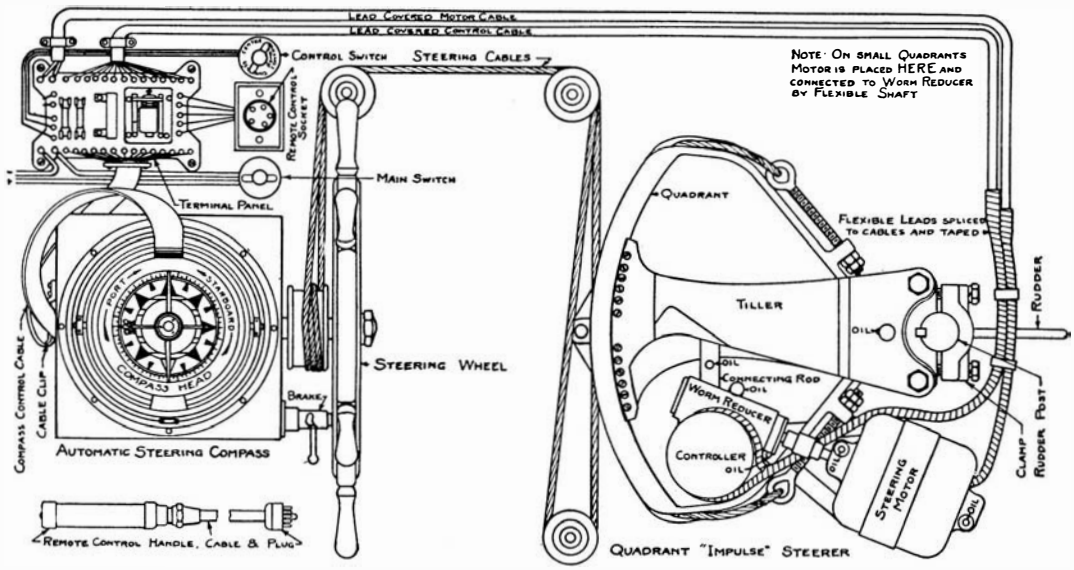
Samples from the roof, which was built in 1909, recently were carefully measured, weighed, and subjected to microscopic examination, as well as checked in accordance with other methods of laboratory procedure to determine what had been the effect on the monel metal roof of nearly a generation of exposure.

It was found there had been little or no physical effect in the material, or loss of weight. So slight was the impairment, due to corrosion, of its value for roofing purposes, that it was said the roof could last a minimum of three centuries.

Insulin, Fattener for Thin People?

FOR healthy lightweights who otherwise cannot be stuffed to pleasing plumpness, Dr. Harry Blotner of Peter Bent Brigham Hospital, Boston, recommends insulin, valuable diabetes remedy.

In a recent report to the American Medical Association he describes the results of this use of insulin in 19 healthy but skinny persons. They all gained weight immediately on three daily doses of ten units of



Schematic diagram of the automatic yacht steerer, showing the hook-up of the compass with the steering wheel and the connection of the wheel with quadrant and tiller by means of cables. The remote control handle is shown in lower left hand corner

insulin. Most of them held the gain after stopping the insulin. The dose was varied in a few cases.

Dr. Blotner found from careful study of these persons that insulin probably increases the appetite, so that the individual eats more; increases the assimilation of the food; acts as a tonic, making the individual feel stronger, more active and less nervous. There are apparently no bad effects from the use of the drug for this purpose.—*Science Service.*

Automatic Yacht Steerer

AUTOMATIC steering equipment, for years available for large ships, is now produced in sizes adaptable to yachts and ships from 30 to several hundred feet long. This equipment, called the Holmes Steerer, is a product of the Automatic Compass Corporation of New York. Some of its advantages are: Release of the helmsman from the wheel; dependability of steering (the machine is tireless, continuously on duty); accuracy of course; economy of operation (the steerer requires only about 50 watts from a storage battery, and saves fuel because it uses less rudder than hand steering); and safety at all times.

Essentially, it is an electric steering machine controlled by a magnetic compass. Its heart, the standard magnetic compass, has not been tampered with but is mounted in the usual way in a standard gimbal and binnacle. The control head which governs the steering machine is a small, self-contained, sealed unit that can be removed and replaced on the compass at will, with no exterior moving parts and containing nothing more delicate than an electric coil, a light, rotatable needle and electric contacts.

The steering mechanism is built into a sturdy quadrant mounted directly on the rudder post. It occupies little more space than the usual quadrant. It employs an improved form of the famous "impulse" method of steering. Briefly, the action consists in applying to the rudder a series of periodic swings or "impulses." Between impulses the rudder is allowed to "trail"—return to its mid-ship position. Thus when the vessel sheers she is restored to her course by a series of individual steps rather than by a swing. Therefore she can not over-swing—the steering is "straight line," stable or "dead beat" with a minimum of rudder and an accuracy frequently better than one degree.

Special consideration has been given to the change from hand to automatic steering and vice-versa. The first literally consists of setting the desired course on the head, putting the helm amidships and closing an electric switch. At all times the wheel is available for hand maneuvering and in emergencies the boat can be taken over by hand without turning off the electric switch.

A remote control device is also available which consists of a small hand controller with a flexible cord connection. It may be taken to any part of the boat and the Automatic Steerer controlled by hand from it. It lends itself to many uses such as sword-fishing or steering from a forward cockpit.

The automatic steering compass is a standard Ritchie liquid magnetic "underlit" compass similar to the model supplied by Ritchie to the United States Navy, but especially adapted for automatic steering. It is mounted in the usual gimbal ring, and may be installed in any appropriate binnacle. Illumination is provided by electric light under the compass.

The working parts of this head are:

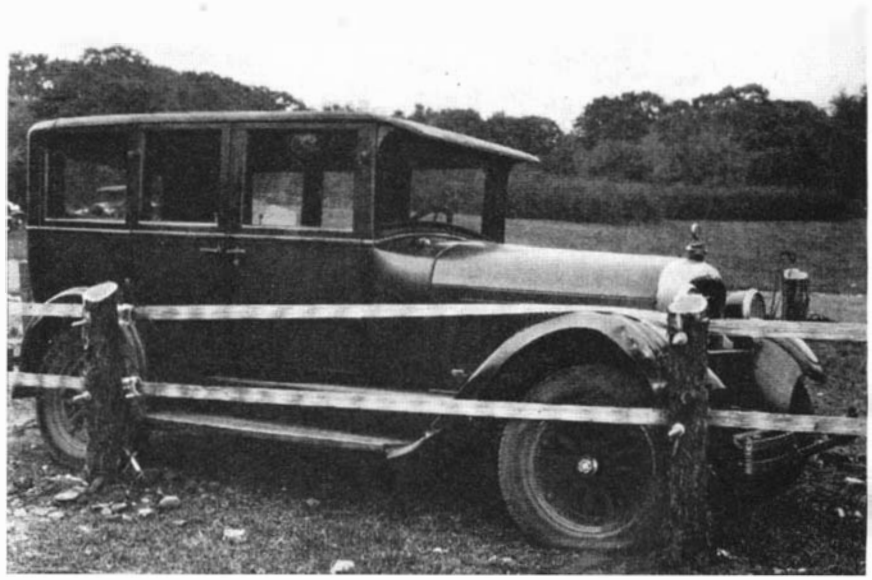
1. A freely moving contact arm—carrying a magnet needle.
2. A rotatable ring with the above-mentioned electric contact segments mounted on it and arranged in two series, Right and Left.
3. An electro lifting magnet.

The contact arm has a pivot at its bottom which rests on a plate of glass. Magnetic interlock between its magnet and the compass magnets causes the contact arm to follow the compass with an accuracy of better than ¼ degree.

Periodically (about once a second) this arm is lifted by the electro lifting magnet and makes contact with one or another of the contact segments on the rotatable ring. A current is thereby caused to flow through the particular contact touched.

The rotatable head has an azimuth circle graduated in degrees to conform to the compass card. The course is set by rotating the head until the desired course appears over the lubber line. The automatic control will then apply rudder to bring the vessel to the set course and hold her there. Changes or corrections in course can all be made at will by simply rotating the head.

The equipment consists of compass, binnacle, compass head, quadrant steerer with motor, terminal panel, wheel brake, control



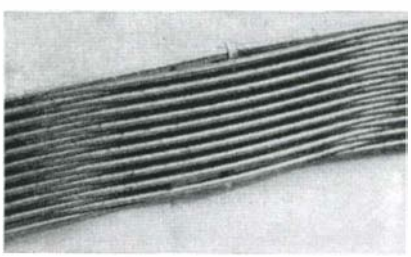
Action under impact of the Traffic Tape described on opposite page

switches and control cable. Remote control consisting of control handle, cord, plug and socket is sold separately.

Wire Tape Guard Rail

HINGED posts, freak construction, and complicated spring arrangements on highway guard rails are eliminated by the use of a new tape which is composed of woven wire. Elimination of the helical twist is said to increase the strength, while the increase in width gives greater visibility. Also, the increased width reduces damage to vehicles because of the wider surface at the point of impact.

This new tape, produced by the Page Steel and Wire Company and called Page Traffic Tape, is erected as simply as is ordinary round cable. It is rigid in the



Section of new guard rail tape

plane vertical to the ground but flexible in the plane parallel to the ground so that it acts to stop a vehicle gradually. After accidents, the maker claims the guard rails composed of this tape are easily and inexpensively repaired. Due to the tape's flexibility, under impact, less post breakage is also claimed.

The tape is composed of 21 cable wires woven flat, 2½ inches wide, and held to shape by cross wires every few inches of its length. Its finish is hot galvanized so that it presents a silvery white appearance with good visibility both day and night.

Arsenic Improves Concrete

THE resistivity of concrete against the attack of water can be substantially improved by impregnating with arsenious acid, according to a patent taken out by O. C. A. Falkman and A. R. Lindblad, of Stockholm, Sweden. The inventors claim that a good effect is obtained by coating or spraying the surface with an aqueous solution or suspension of arsenic anhydride. For more solid constructions, such as bridges, dams, and quays, it is recommended that the impregnating agent be applied by means of pressure, in order to attain a more thorough penetration of the concrete mass.—*A. E. B.*

New Chemical Process of Extracting Copper

CHILEAN chemists have worked out a new process for the extraction of copper from its ores by the use of iodine, an element of which the country has abundant natural supplies. According to *Industrial and Engineering Chemistry*, the process is based on the affinity of iodine for copper. By means of this process, all copper is precipitated as cuprous iodide, unmixed with any other iodides. Thus, with the industrial development of this process,

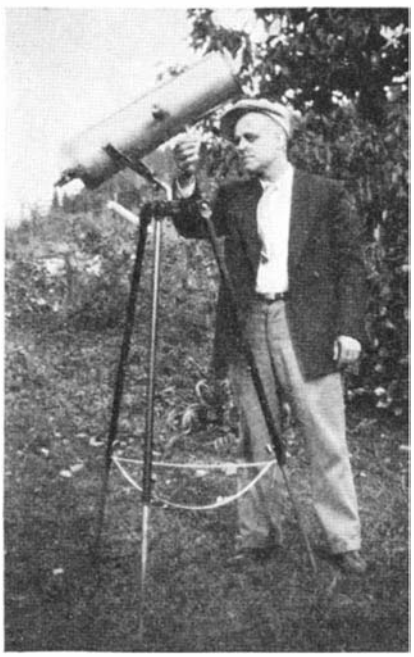
(*Please turn to page* 243)

THE AMATEUR ASTRONOMER

Conducted by ALBERT G. INGALLS

PORTABLE telescopes like the one made by C. R. Wassell and described in this department last November can be thrown into a car and transported beyond the glare of city lights. More portables have now been made and here are notes on three of them.

The first is by George Croston (who usually signs his name Xton) of La Grande, Washington, secretary of the Amateur Telescope Makers and Astronomers of Tacoma (also see A.T.M., page 444), who writes:



Left: **Xton and his portable telescope.** ***Above:*** **The same, folded up**

"My portable compound telescope was built for service on Mt. Ranier. It is a triple telescope, so constructed that it can be changed quickly to a Newtonian, a Cassegrainian, or a Gregorian, as desired. The six-inch mirror works as a Newtonian at *f*/3. The Cassegrainian secondary and the Newtonian diagonal are both mounted on a turret, an extension of which projects through the aluminum tube and is rotated by means of a knurled knob, in order to bring up the desired combination. To use the telescope as a Gregorian this turret combination is removed as a unit, leaving the Gregorian secondary which is permanently in place.

"The weight, including the tripod, is 24 pounds. The upper section of the telescoping tripod legs is of airplane steel tubing and the lower of duralumin. Each upper section of the tripod has a small steel cone brazed on it to fit a corresponding recess in the outer edge of the mirror cell, and thus the three legs are drawn and held tightly in place by means of three center-connected airplane turnbuckles. This provides a rigid assembly for transportation, also protection for the tube and a convenient handle for carrying, as is shown above.

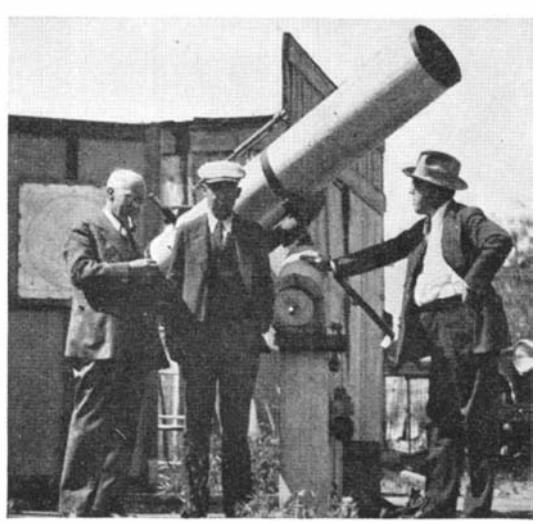
"The tripod head is made to such a diameter that the open end of the tube will nest in it, providing a tight cover that protects all the optical surfaces from dust and possible damage in transit, as well as a convenient base on which to store the telescope.

"This instrument was made mainly for terrestrial observing but it performs well in astronomical work on the Cass and Greg combinations. The Newtonian, having such a short effective focal length, corresponds in design characteristics to a very large field glass, giving a brilliant wide field of low power. Vibration is the principal disability experienced with this type of telescope when used in astronomical work. However, this one soon comes to rest. Vibration is a price which one must expect to pay for portability and extreme lightness combined with high power.

"The secondaries are 1⅝ inches in diameter. By using the Kirkham direct focal test (A.T.M. page 271—*Ed.*) they were accurately figured. Their small diameter would have made this a difficult job by any other method. They have micrometer adjustments in three directions, accuracy in this respect being absolutely necessary to good performance.

"The photographs used in the new edition of A.T.M. to illustrate the Ronchi test were made from the mirror used in this instrument. This is also the first mirror to be figured and tested by this method." (Messrs. Kirkham and Croston live near one another and often co-operate.—*Ed.*)

Johnston's telescope—and daughter



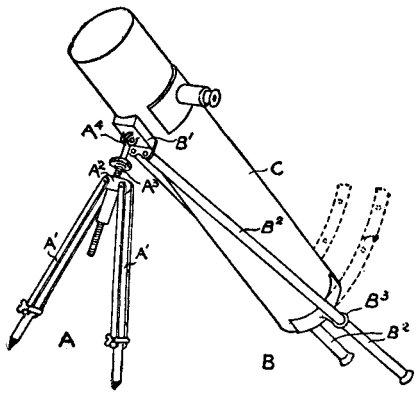
Left to right: **Russell W. Porter, Harold A. Lower of San Diego, and Byron L. Graves of Los Angeles, hobnobbing at Lower's observatory. The photograph by James C. Critchett**

A NEAT portable telescope is that made by Don H. Johnston of The Humphrey Company, Cleveland, Ohio, who writes briefly:

"This is an 8-inch portable job. Full equatorial mounting with slow motions. Pipe fittings are used, and the rest of the parts came from scrap heap. The outfit is very rigid and steady and, owing to the short tube, it can be carried outside and set up easily and quickly. Highest magnification is 187 diameters. The finder is adjustable and eyepiece holder has rack and pinion movement. Focus 37½ inches."

THE Sellers portable altazimuth mounting, made by F. J. Sellers, F.R.A.S., M.E., of 42 Church Crescent, London, N. 10, England, is shown in an accompanying drawing, which nearly explains itself. A^4 is a universal joint. A^3 is a screw for slow motion in altitude. B^2 represents two rods which may be rotated by the hand-

grip in order to move the telescope in azimuth. This tight-fisted control is a very positive one. Quick approximate adjustment is made by spreading the bi-pod sidewise or forward, or both. Both controls are within convenient reach of the eyepiece. The mounting is light in weight. Mr. Sellers is the author of Chapter X, Part X, of "Amateur Telescope Making" and is prominent in amateur astronomical circles in England.



The Sellers portable altazimuth

ON page 410 of the new edition of "Amateur Telescope Making" the two mentions of caustic soda, in lines 14 and 15, should be changed to caustic potash. On page 233 in Editor's Note change Ohio State to Ohio Wesleyan. Please don't forget to hunt for further errors in A.T.M. as you read, and report them to us. Ten thousand pairs of eyes are better than one, and we are anxious to locate the mistakes —and we don't say "if any," since it is common experience that newly published matter usually contains them.

PRELIMINARY plans are being worked out for a national get-together of amateur telescope makers, to be held in Chicago, probably in June. The following note concerning it is from Arthur Howe Carpenter (A.T.M., page 380), president of the Amateur Telescope Makers of Chicago: "This organization," he writes, "will be host to all members of the telescope making fraternity in the nation and we should like the event to take place in June, concurrently with the meeting of the American Astronomical Society, which is set for June 21-25. We should like to hear from prospective visitors as soon as possible, in order that we may make plans. Address 811 Bell Avenue, La Grange, Illinois."

As you will gather, the plans for this national convention have not yet fully matured, but you will be informed through this department regarding any changes. At present the American Association for the Advancement of Science also proposes to hold its summer meeting in Chicago between June 19 and 30. The sessions of this great meeting are open to anyone interested in science and willing to pay small membership fees (less than five dollars). The Chicago group hopes to have a headquarters booth open throughout the summer, where amateur visitors may hobnob with them and actually work with them. So here are two added inducements and three great conventions of scientists!

A national organization of amateurs will also be effected at this meeting.

CURRENT BULLETIN BRIEFS

Short Reviews of Bulletins and Papers on Scientific and Allied Subjects, and Where to Get Them

HOUSING OBJECTIVES AND PROGRAMS (a publication of the President's Conference on Building and Home Ownership), edited by John M. Gries and James Ford, gives the reports of the correlating committees on technological developments; legislation and administration; standards and objectives; education and service; organization programs, local and national; and research. It includes the addresses of President Hoover and Dr. Ray Lyman Wilbur. It is a bound book of 345 pages. Make checks and money orders payable to *James Ford, President's Conference on Home Building, New Commerce Building, Washington, D. C.—$1.15; foreign $1.25.*

BAILEY BOILER METERS (Bulletin No. 44) afford an accurate, reliable and efficient guide for boiler operations. They show exactly what the operating conditions are at every instant and furnish the necessary information for correcting faulty conditions as soon as they occur so that maximum economy may be maintained at all times. Much valuable information is given in the bulletin. *Bailey Meter Company, Cleveland, Ohio—Gratis.*

AIRWORTHINESS REQUIREMENTS FOR AIRCRAFT COMPONENTS AND ACCESSORIES (Aeronautics Bulletin No. 7-F). These regulations apply to all important components and accessories which are manufactured as complete units and purchased by aircraft manufacturers and (or) operators for use on licensed aircraft, except engines and propellers which are treated separately in Aeronautics Bulletin 7-G. *Aeronautics Branch, U. S. Department of Commerce, Washington, D. C.—Gratis.*

CANCER THEN AND NOW is a large pamphlet dealing with the subject of cancer, its treatment and control; charts and educational exhibits are included. *New York Cancer Committee, 34 East 75th Street, New York City—$1.00.*

ANNOTATED BIBLIOGRAPHY ON THE HYGIENIC ASPECTS OF ALUMINUM AND ALUMINUM UTENSILS (Bibliographic Series, Bulletin No. 3, Mellon Institute of Industrial Research) is a splendid work which will do much to foil the insidious propaganda against aluminum utensils which has sprung up in the past few years. The whole is boiled down and documented in an orderly way. We are glad to have been one of those who have proclaimed the harmless nature of aluminum as a material for the fabrication of cooking vessels for all culinary purposes. Aluminum is as well adapted for the hospital kitchen as for the home. The introduction is by Dr. George D. Beal and the preface is by Dr. Edward R. Weidlein. *Mellon Institute of Industrial Research, Pittsburgh, Pa.—Gratis.*

EDGE MOOR WATER TUBE BOILERS (Catalog No. 69) describes the modern trend toward increased pressures, ratings, and capacities. This pamphlet deals with the bent tube type. With riveted drums, pressures up to 450 pounds per square inch can be maintained and with special construction higher pressures can be maintained. Seamless steel drums can be built to any desired pressure. Various details of manufacture are illustrated. *Edge Moor Iron Company, Edge Moor, Delaware—Free to interested parties using printed letterhead.*

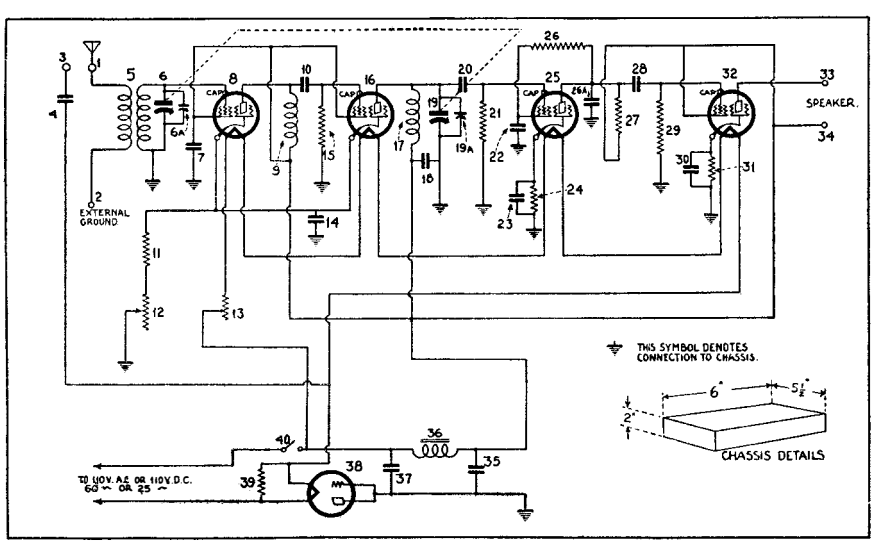
THE FAR EAST PROBLEM (International Conciliation, January, 1933, No. 286) gives the official texts and summary of the Lytton Report. It includes a number of documents. *Carnegie Endowment for International Peace, 44 Portland St., Worcester, Mass.—5 cents.*

FOREIGN COMMERCE AND NAVIGATION OF THE UNITED STATES contains complete official figures for every commodity in the 1931 trade of the United States with every foreign country. It gives the number and tonnage of vessels entered and cleared. There are 872 pages (quarto size) and the book is bound in buckram. *Superintendent of Documents, Washington, D. C.—$1.25 (money order.)*

GIANT FORGING PRESSES WITH PRESSURES UP TO TWENTY THOUSAND TONS (*Hydraulik Review*) describes a huge press for making armor plate and war materials. The fabrication of the component parts is most interesting. *Hydraulik g. m. b. h. Duisberg, Germany—Gratis.*

EX-CELLO BORING MACHINES (Catalog No. DB 3132) describes in detail precision boring machines designed for extremely accurate production work particularly where diamond, tungsten carbide, and tantalum carbide boring operations are involved. Typical set-ups are shown, as well as illustrations of finished parts. The machines are manually and hydraulically controlled. *Ex-Cello-O Aircraft and Tool Corporation, 1200 Oakman Boulevard, Detroit, Michigan.—Gratis.*

RE-REFINING 12 BRANDS OF OIL describes how the Tide Water Oil Company took 12 competitive oils and re-refined them using the Edeleanu machine. The Edeleanu process is a purely physical solvent process and operates without any chemical reaction taking place between sulfur dioxide and oil. The re-refining disclosed many conditions of interest to users of turbine or Diesel oils—*Tide Water Oil Company, 17 Battery Place, New York City—Gratis.*



THE "PAL" PORTABLE RECEIVER is an extremely compact five tube set, powerful enough to operate a loudspeaker with ample volume. It can be operated on 110 volts alternating or direct current, without any changes whatsoever in the tubes or in the wiring. An important feature is the fact that the usual power transformer has been eliminated, thus cutting down cost. Eveready heater type tubes are used. A piece of wire thrown on the floor, or a ground connection, serves as an aerial. The set weighs only a few pounds and can be carried in an ordinary handbag or suitcase. It is ideal for the traveller, for the summer home, or as a second set in the home. Excellent selectivity is obtained through the use of Litz-wound Find-All coils. A small cone-type magnetic speaker is used. This set will bring in a satisfactory number of stations. Last, but not least, the "Pal" contains very few parts and hence it is easy to assemble and wire and costs less than the ordinary midget. Top and bottom views, list of parts and additional information may be obtained from *Allied Engineering Institute, Suite 541, 98 Park Place, New York, N. Y.—10 cents.*

THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page* 239)

a refined copper suitable for industrial purposes is produced.

The principal advantage of this new process consists in the possibility of applying it, at a minimum cost, to all the ores of copper, even those which require a large amount of sulfuric acid, as the process liberates a large amount of this acid during the precipitation of the cuprous iodide. In other words, this process, besides precipitating the copper from any solution, liberates at the same time a quantity of sulfuric acid. It allows small plants to produce refined copper at prices which compare favorably with those of large producers, while permitting the large producers to lower their cost of production materially.—*A. E. B.*

Improved Pasture Pays

IMPROVED pastures are a cheap source of feed for stock. A farmer in New Hampshire, co-operating with his county agent, top-dressed his five acres of pasture with 500 pounds of complete fertilizer at a cost of 75 dollars, reports the United States Department of Agriculture. After four weeks he turned his cows on this pasture. Tests made during the six weeks the cows grazed there showed that his herd produced 7000 pounds more milk than they did in the same period the previous year, although the farmer had one cow fewer and fed 800 pounds less grain. Based on current milk prices he made 189 dollars on the extra milk and saved 16 dollars on the grain, netting him an increase in income of 130 dollars.

Chemistry in Construction

THERE is a virgin field for the chemist in building construction, according to F. E. Schmitt, writing in *Chemical and Metallurgical Engineering*. There is a wide range of opportunity to develop better floor surfaces and improved facing materials or units for walls and ceilings, says Mr. Schmitt. Plaster surfacing, one of the most ancient elements of building practice, is at the same time one of its weakest and most costly elements, and its elimination would constitute a vital simplification of building. External wall surfaces offer an opportunity almost as great, for the possibility of the application of light and adaptable plastics appears most attractive.

Asphalt, tar, and Portland cement have made the modern road possible. Without these substances the automobile could never have been developed to its present importance or highway transportation been raised to its new significance. These products of chemical industry, together with another, the rubber tire, are directly responsible for the creation of billions of dollars of new wealth, and the corresponding development of vast new productive power throughout the world. But perhaps the chemist can go still farther.

Methods of treating earth and stone to produce more permanent surfaces, possessing greater stability and wear resistance

and of readier adaptation to different forms of base, afford a wide prospect for new advances. Low-cost construction methods for minor roads are now the center of interest, but they present problems as yet unsolved.

Waterproofing and protective coatings—paints, varnishes, lacquers and whatnot—form one of the most highly developed fields of chemical industry as applied to construction. Their antiquity alone should assure this, for did not Noah waterproof the outer surface of his ark and probably also paint its interior? Yet the actual facts of present-day practice are none the less disappointing. The leaking cellar, the costly building penetrated by rain water to the destruction of fine trim and finish, the continual trouble and expense of renewing paint coatings, are all too well known to permit us to look on this art as being in a satisfactory state. The chemist still has much work to do in furnishing better materials and methods to the building constructor by which he may assure the exclusion of water and obtain durable, protected surfaces.—*A. E. B.*

Acid Finishes Electric Bulbs

THE inside of electric lamp bulbs is being etched in France by a machine which squirts hydrofluoric acid into the bulb through a nozzle. Because these nozzles had to be replaced frequently due to the acid's corrosive action, they are now being made of a nickel-copper-chromium cast iron which withstands the acid attack very well.

White Leghorns Bask Under Sunlamps

WHEN biddy gets her ultra-violet, she lays more and better eggs, her output has greater hatchability, and she lives a healthier and longer life.

The experience at the Mile-High Poultry Farm in Denver, Colorado, where a large installation of Sunlamps for poultry has been made, parallels many others throughout the country. Mr. P. C. Schreiner, president of the farm, and his manager, Mr. L. D. Black, some time ago became interested in the possibility of increasing their profits by irradiating the hens. With the assistance of Mr. L. Sessions, of the General Electric Company, they conducted a preliminary test on which they report as follows:

"On December 10, 1931, 12 Sunlamps were installed temporarily to test the effect on 450 hens. Another group of 450 hens in a pen equipped with ordinary incandescent lamps for early morning lighting, was placed under observation. During the first two weeks, hens dependent solely on conventional light sources held about even with their irradiated neighbors. Beginning January 7, 1932, however, the difference began to manifest itself. From that time until March 12, when the test ended, irradiated hens produced in steadily rising ratio more eggs per day than their less-favored sisters. The final checkup showed 12 percent more eggs of 16 percent greater fertility from the sunlamped poultry house.

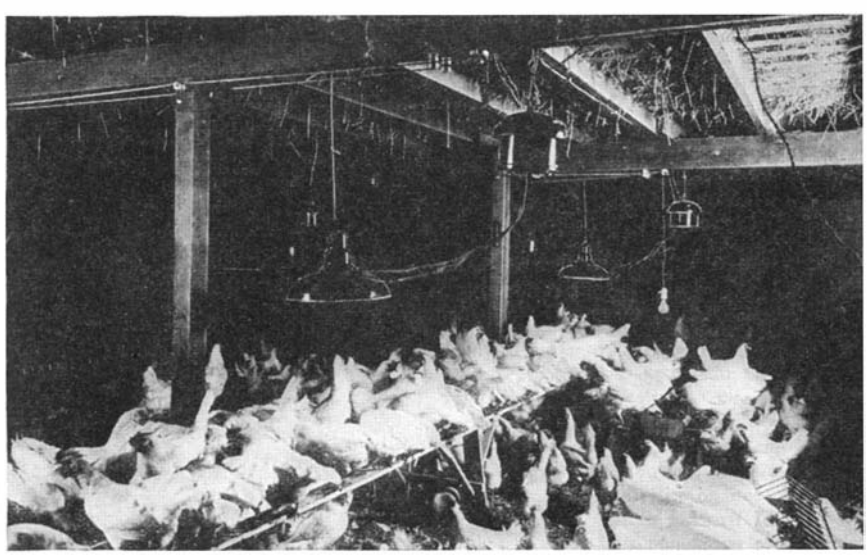
"In addition to other benefits derived, observation showed that sunlamped hens resisted disease much better than those which were not, and Sunlamp treatment cured 'hospital' cases in one third less time than ordinary methods. Mortality is also at least 5 percent lower among irradiated hens—an important factor where individual members of the flock are worth upward of 100 dollars apiece, and fertile eggs bring 50 to 75 dollars a setting.

"Mr. Black found that hens under Sunlamps came through the moult in one half the usual time; that they produced eggs hatching strong chicks entirely free from weaknesses that formerly prevailed."

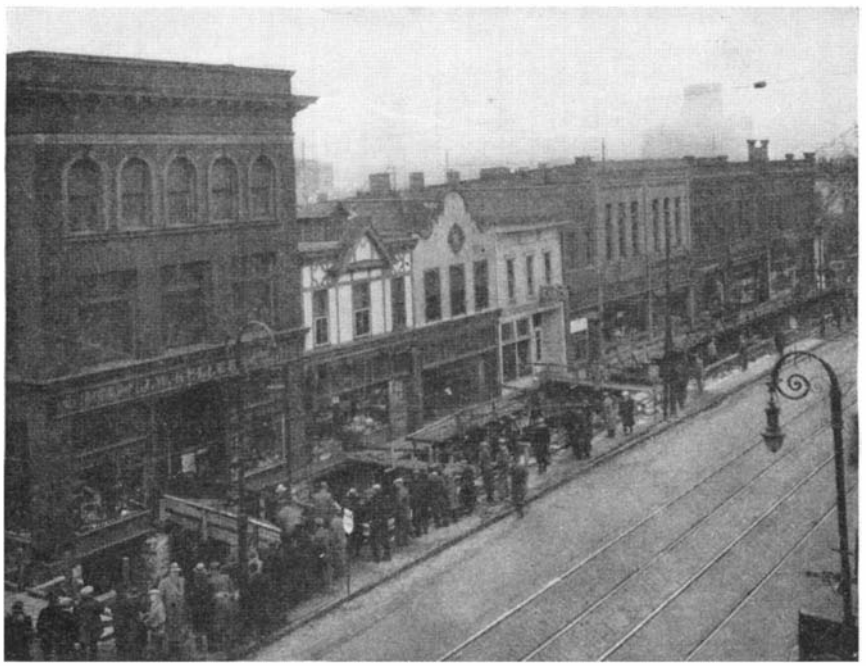
Iodine Encourages Hens

FEEDING potassium iodide to chickens is said to accelerate the development of the hatching instinct, increase the laying capacity, and produce eggs containing 300 to 400 milligrams of iodine in readily assimilable form, according to German experimenters. A recent report on the results of prolonged research states that a number of chickens were fed a daily ration of 2 milligrams of potassium iodide, which resulted in an average increase in egg production of 3.5 percent.

While the iodine content of ordinary eggs, exclusive of the shell, is from 4 to 7 milligrams, the eggs laid by iodine-fed chickens contained as much as 300 to 400 milligrams iodine. The content showed, however, considerable variations. The highest figures mentioned were found after feed-



An installation of Sunlamps that increases egg production



An entire city block moved on steel rails by means of jacks

ing potassium iodide for three weeks, during which time the iodine content in the eggs gradually increased. On discontinuing the iodine diet, a gradual decrease of this element in the eggs was observed, which finally sank down to normal. Most of the iodine present in the eggs was concentrated in the yolk, a much lesser amount in the white, and in insignificant quantity in the shell.—*A. E. B.*

Sandy Ore Used For Rust-Proof Paint

TAKING advantage of a domestic ore that contains a suitable agglomerate of ferric oxide, silica, and alumina, the Eastern Mabelite Corporation, New York, produces a protective coating for use on metals. The vehicle of "Mabelite" may be any normal oil paint, and tests indicate that the mineral content affords abnormal protection against atmospheric conditions, mild solutions of acids and alkalis, and brines. The silica content furthermore protects it from abrasion. In practice it has been successfully applied to metal pipe line, tanks, and concrete.—*A. E. B.*

Whistle Blast Moves Entire City Block

A WHISTLE blast, a few groans from laboring push jacks, a grunt or two from the men operating them, and an entire city block steps back to give elbow room to increasing traffic needs, says an article in *The Yellow Strand*, a publication of Broderick and Bascom Rope Co.

Mr. E. W. La Plante, of La Plant-Choate Manufacturing Company, accomplished this feat in Toledo, Ohio. Sixteen push jacks, turned at the command of whistle signals, moved 14 stone and brick structures with the smoothness of clockwork. The time required actually to move these buildings a distance of 15 feet was only 12 hours, but several weeks of preparatory work paved the way.

"Business as Usual" was the slogan of the tenants who were being taken for this ride. Not for one moment were they disturbed or deprived of water, gas, electricity or sewerage facilities.

The moving equipment on the Toledo job included 340 tons of steel rails and I-beams, 1500 crib jacks and 1700 50-pound steel rollers.

Excavations were first made for the foundations and new basements. A bed of concrete was laid to serve as a level for the tracks on which the buildings were to move. The walls were bridged through with steel rails, then loaded on the rollers.

When all this had been done, with the push jacks in position, Mr. La Plante blew his whistle and the backward journey began. With less vibration than would have been caused by the passing of a heavy truck, 2,500,000 pounds of buildings rolled back to new positions.

Cigarette Tar in Cancer

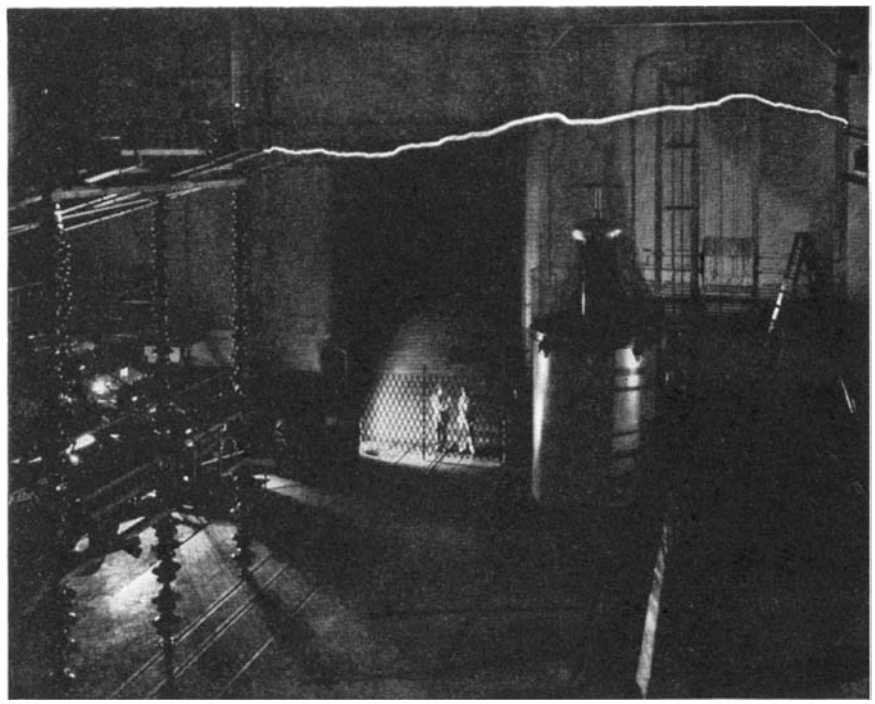
CIGARETTES were both blamed and exonerated of the charge of causing cancer in two recent articles in the *American Journal of Cancer.*

Dr. William D. McNally, assistant clinical professor of medicine at Rush Medical College, Chicago, holds that the tar of cigarette smoke contains irritating substances which could account for the recorded increase of cancer of the lung.

Dr. Emil Bogen and his associate, Russell N. Loomis, of Olive View, California, contend that whatever cancer-producing effect the use of tobacco may have, it cannot be ascribed to the chemical effect of the tar in tobacco smoke or distillate.

The tar of cigarette smoke, Dr. McNally found, contains nicotine, ammonia, and other substances, all irritating, which could account for "cigarette cough," for the chronic bronchitis of the cigarette smoker, and for a condition found in heavy smokers known as leukoplakia, or smokers' tongue or smokers' patches. These irritating substances could also account for the increase in cancer of the lung which has been recorded in recent years.

"The temperature is not an important



This photograph was taken in the General Electric high-voltage laboratory by the light of a flash of man-made lightning crashing across a gap of 30 feet, under a pressure of 10,000,000 volts. The same voltage will form an arc 60 feet in length, if space allows. The discharge is accompanied by a loud crash

factor unless the cigarette is burned down to the last centimeter, when the hot smoke becomes more irritating," Dr. McNally reported.

"With a tarry residue of 4.84 to 15.29 percent, a definite risk attaches to the smoking of a cigarette, especially since 6.56 to 11.58 percent may be absorbed or retained in the body. Cigarettes should not be smoked too short, as the last two centimeters retain most of the tar and other products of incomplete combustion."

Dr. McNally's report was based partly on observations of other investigators and partly on his own observations of the effect on rats of the water-soluble products from the smoke of 100 cigarettes. These were sprayed into the mouths of some rats, applied back of the ear to others and on shaved spots on the backs of still others.

In this study, tobacco tar was applied to the back of the necks of one group of white mice, and gas-house tar, known to have cancer-producing properties, was applied to the back of the necks of another group. In the first group there were no skin changes, while in the second, the usual common type of tar tumors appeared promptly.

"In the light of these findings, it appears highly improbable that the tar obtained during the act of smoking is an important factor in the development of cancer of the oral cavity of man," Dr. Bogen and Mr. Loomis concluded.

These findings, however, do not invalidate the prevailing, though not quite unanimous, clinical observation that cancer of the mouth is unduly prevalent among persons accustomed to using tobacco. Even though the tarry substance settling out from the tobacco smoke may not show any cancer-producing properties, there are many other factors involved in smoking which may prove cancer-producing.

Among these the California investigators mentioned the mechanical irritation from the presence of a solid object in the mouth, such as pipe or cigarette holder; the temperature of the smoke which may produce imperceptible repeated burns of lips and tip of tongue; and the effect of other substances in the tobacco smoke, though there is as yet no evidence that any of these substances actually can produce cancer.

"Any substance so widely and commonly used as the cigarette cannot be as dangerous and deleterious as the propaganda of the more fanatical 'no-tobacco' advocates might lead one to infer," the Californians pointed out.

A moderate amount of smoking may not produce visible injury in a sound individual, they reaffirm. However, the possibility of damage not perceptible by casual observation cannot yet be ruled out.—*Science Service.*

Organic Chemist Wins Chandler Medal

ONE of the most colorful careers in contemporary chemistry was hailed by the profession recently when Dr. George O. Curme, research director of the Carbide and Carbon Chemicals Corporation, was awarded the Chandler Medal for 1933. Fifteen years ago, Dr. Curme, a quiet, studious young chemist was "playing" with organic chemicals in a laboratory, amusing himself by combining the common elements carbon, hydrogen, and oxygen in various ways to produce compounds of no particular value except for their scientific interest. Today, a great chemical industry has grown up out of Curme's test tubes, and the products of that industry are sold by the carload.

Dr. Curme's original work, done in 1915-16, involved the production of acetylene. Subsequently he worked out practical methods for the production of ethylene glycol, ethylene dichloride, ethylene chlorhydrin, ethylene oxide, diethyl sulfate, di-

chlor ethyl ether, and many other compounds. Today the production of ethylene glycol, ethylene dichloride, ethylene chlorhydrin, and other compounds runs into many millions of pounds annually.

Professor Arthur W. Hixon, of Columbia University, in awarding the medal, termed Dr. Curme "one of the greatest living exponents of aliphatic chemistry" and declared that Dr. Curme "heads the list of those who have brought the leadership in organic chemistry from Germany."—*A. E. B.*

Foreign Flower Brings Menagerie of Insects

A SMALL insect menagerie recently came into the United States with a shipment of orchid plants, carefully wrapped in dried leaves. The presence of the insects in the innocent-looking package was detected by plant quarantine inspectors of the United States Department of Agriculture, who examine all plants and plant material offered for entry at American ports to exclude foreign insect pests and plant disease.

This package gave no outward sign of being a hive of insect activity, but the Federal inspector found that it harbored the following undesirable aliens: nine species of ants, five kinds of beetles, five species of cockroaches, two moths, one cricket, one predacious bug, and one insect living on decayed matter. The infested orchid plants were detained until they had been fumigated and the original packing replaced by excelsior.

World's Smallest Fastest Grinder

A NEW air grinder, small enough to be concealed in the palm of the hand, yet having a tested grinding speed of 40,000 revolutions per minute, has just been announced by the Madison-Kipp Corporation, Madison, Wisconsin.

The new tool, appropriately known as the Blue Midget, weighs only seven ounces. It has been developed to fill the need for a small, yet exceptionally efficient air grinding tool for all light work and intermittent service. Tool makers, die makers, and mechanics find many uses for it.

The factory method of testing this grinder is most interesting. Every Blue Midget must prove itself able to hit the musical note of high F sharp. Through the method known as "tone testing," vibrations per minute are automatically transferred to revolutions per minute, thus furnishing an accurate and reliable verification of the grinder's 40,000 revolutions per minute speed.

Increased Use of Gas for Domestic Heating

REVENUES from manufactured gas in the United States in 1932 aggregated about 413,250,000 dollars, representing a decrease of 5.1 percent from the 1931 figure.

While total sales of manufactured gas to consumers registered a decline of 4.8 percent, according to the preliminary estimates of the Association's Statistical Department, an outstanding exception to the general trend was the increase shown in the use of gas for house heating purposes. In 1931, sales of manufactured gas for house heating purposes were 19,908,100,000 cubic feet but during 1932 this figure rose to 20,445,600,000 cubic feet, an increase of 2.7 percent in this class of business.—*A. E. B.*

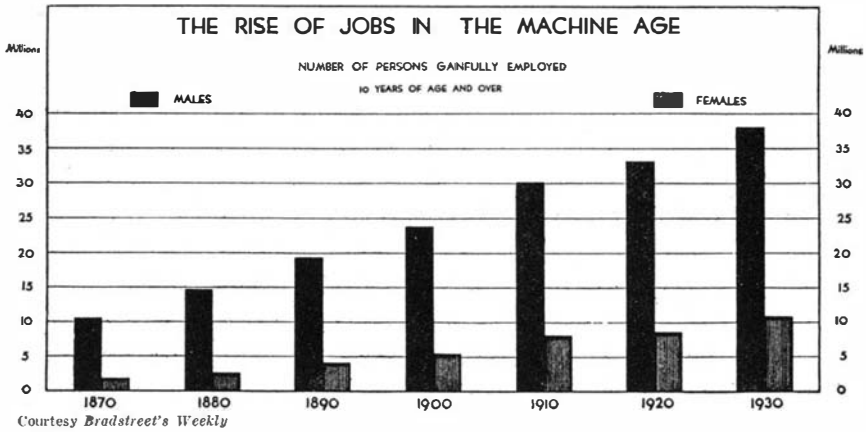
A Better Bathinette

THE Machine Age helps even the babes in the bath. A temperature-controlled baby bath has been installed in Grace Hospital, Detroit, according to *Modern Hospital Magazine*. Made of monel metal, the bath is of particular interest because a heating coil is built underneath its entire length. The temperature of the bath is kept constant by the use of a thermostat governing the heating coil.

Steam Ejector Refrigeration Equipment

USING steam ejectors to produce the cooling effect, a tank of several hundred gallons of water at room temperature was frozen to a slush ice in a few minutes in a recent test of refrigerating equipment in Philadelphia. Except for some small pumps, there was no rotating apparatus in

When the Bureau of Standards wants to know facts concerning the duration and intensity of fires, they do not theorize, but instead simply start a fire in this building, after furnishing it to simulate any desired occupancy. The temperatures are then measured at many points within the house by thermocouples



Courtesy *Bradstreet's Weekly*

Technological unemployment refuted. This graph shows the steady rise in employment since 1870. Since that time, as the population has increased, the percentage gainfully employed increased from 32.4 in 1870 to 39.8 in 1930

this equipment, and the complete unit was simple and relatively small in size. This ejector equipment is particularly adaptable for many types of refrigeration applications where process steam is available. Air-conditioning is a particular field where a wide application should be found for it; there are also many other potential industrial uses.—*A. E. B.*

Newspaper Savings

A LONDON newspaper, says the *Nickel Bulletin* (London), saves 300 casts per week by nickel-facing short page stereotypes. Nickel-faced printing plates are practically as hard as steel and will stand up to 1,000,000 runs, enabling economies to be effected in the cost of renewal of plates.

Many newspapers in the United States and Canada are also using nickel-faced plates.

Scientific Piano for Radio City

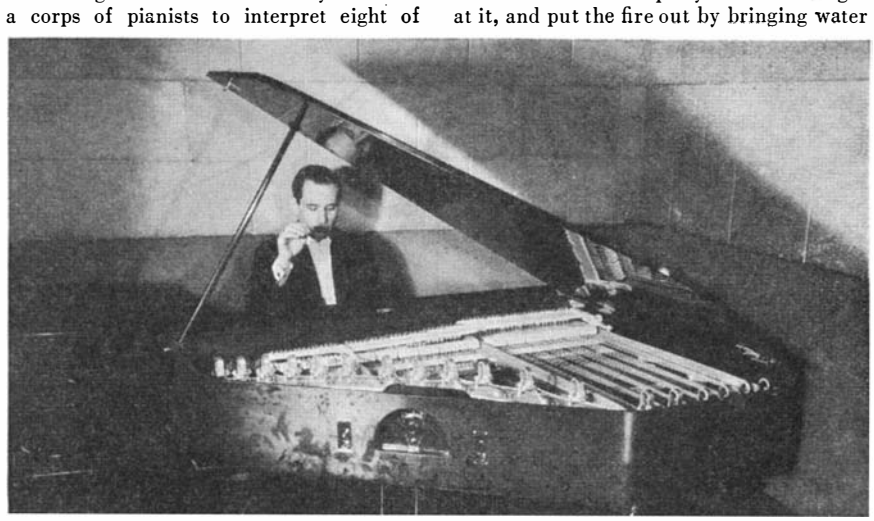
WHAT is said to be the first revolutionary change in the piano in 200 years is embodied in a new Hammond-Bechstein instrument which has been imported from Germany to be introduced to America in Radio City theaters. In this type of piano, the sounding board of the average piano is replaced by 18 microphones which amplify the tones and produce the effect of any given instrument in a symphony orchestra. Vladimir Padwa was brought over from Germany to teach a corps of pianists to interpret eight of these instruments which will be used in the Radio City Music Hall and the RKO Roxy Theater in New York.

Red Zinc Oxide

ASK any chemist to describe zinc oxide and he'll probably tell you first that it is a *white* powder. Indeed, zinc oxide is notoriously white—yet recent reports from Germany state that zinc oxide may also be red. Brick-colored zinc oxide has been produced by A. Kutzelnigg by dissolving zinc oxide in molten ammonium nitrate and blowing the superheated fusion. The red color was not affected by boiling in water or by heating to a red heat for a short time. It showed orange fluorescence when treated with ultra-violet light, in the same manner as oxide obtained from nitrate.—*A. E. B.*

Gas from Cave Fire Killed Leaves on Trees

HOW a natural poison gas attack killed leaves on trees 200 feet from its source is told in a recent communication to *Science*. A fire occurred in a New Mexico bat cave, burning for more than three weeks in the accumulation of dry guano. It is conjectured that the fire was started by campers who did not know that it would keep on burning after they left. At any rate, the gases generated were so strong that the first party of forestry workers who tried to approach it were driven back. Later another party was able to get at it, and put the fire out by bringing water



The latest development in pianos. Microphones pick up and amplify the tones

from farther down in the cave. The damage to the trees occurred around the mouth of the cave, where the fumes were strongest. They were apparently fumes of nitric acid. —*Science Service.*

Pure Fish

SPECIALLY developed alloys have enabled the construction of a fish canning machine which will not contaminate the food products with which it comes in contact. All parts of the machine coming in immediate contact with the fish are made of a nickel cast iron which is highly resistant to corrosion. The frames and other cast parts of the machine are constructed of nickel-copper-chromium iron, another corrosion-resistant alloy.

Arc Welding Spheroid Tanks

AS every schoolboy knows, a round field can be fenced with less material than a rectangular or triangular plot containing the same area. Working in the third dimension, as is appropriate for storage tank construction, The Chicago Bridge and Iron Works utilized this rule in the design and construction of two 80,000 barrel storage tanks. These spheroidal tanks, known as Hortonspheroids, are used for oil storage at Longview, Texas, by the East Texas Refining Company. Their construction required less material than cylindrical tanks and because the stresses in a spheroid, due to double curvature, are less than in a cylinder, lighter plate was used. The spheroids before painting are shown in the accompanying illustration.

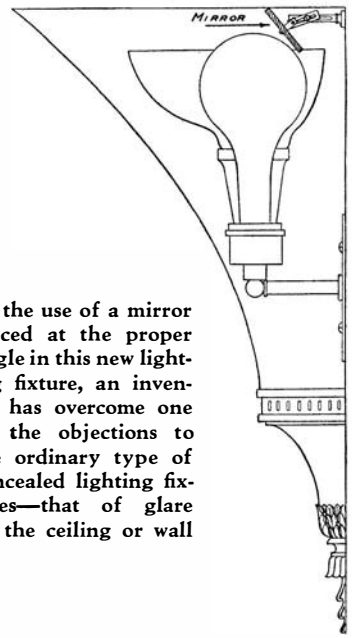
All joints were lap welded by the shielded arc process using welders and electrodes manufactured by The Lincoln Electric Company, Cleveland, Ohio. The tanks were completely welded in the field with no preliminary shop fabrication. Each tank is 136 feet in diameter and 40 feet high.

An interesting fact pertaining to the design of spheroids is that if these tanks were increased to 1,000,000 or 10,000,000 barrels capacity the height would remain constant. Only the diameter would be increased to accommodate the larger volume.

Light Reflecting Fixture

IN lighting fixtures, as in so many other things in this day of high-pressure salesmanship, simple methods and design are often neglected in favor of the complicated and ornate which will have some strange appeal apart from quality and adaptability. An inventor of White Plains, New York, Mr. F. M. Kirby, has apparently taken this into consideration, for a new and extremely simple light diffusion unit which he has invented may be as ornate as the purchaser may desire and yet is more efficient as a light source than most units on the market today.

In previous concealed-light illumination systems, there has been, almost without exception, a splash of light on the wall or ceiling nearest the light source. An objectionable glare and lack of proper diffusion results. Mr. Kirby uses as a simple corrective a mirror placed in the fixture and accurately angled to eliminate this glare-producing splash and scatter the light more evenly over the ceiling. This new idea, shown in an accompanying drawing, promises to solve many of the problems of the architect and the lighting engineer. It is being patented.

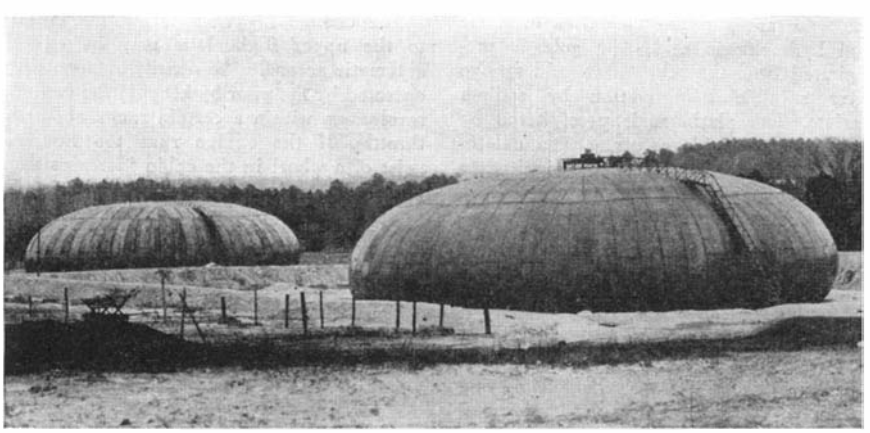


By the use of a mirror placed at the proper angle in this new lighting fixture, an inventor has overcome one of the objections to the ordinary type of concealed lighting fixtures—that of glare on the ceiling or wall

Mosquito Horde Kills Livestock

A FURIOUS attack by a mosquito horde near Miami, Florida, resulted in the death of at least 173 head of livestock and poultry, F. C. Bishopp of the Department of Agriculture reported to a recent issue of *Science*.

While blood loss was an important factor, Mr. Bishopp is of the opinion that the death may have been due to the injection of a toxin by the mosquitoes as well as to



Hortonspheroids that were arc welded in the field

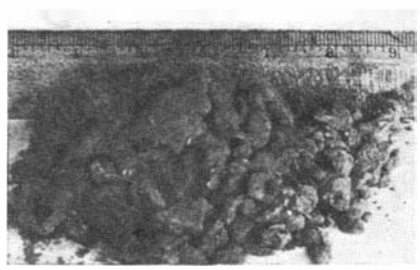
loss of blood. He points out that few of the current reports of fatal attacks on man and animals by mosquitoes have been verified. The check of the losses in this instance was made by T. E. McNeel of the United States Bureau of Entomology.—*Science Service.*

Preventing Acid Attack on Metal During Pickling

METAL surfaces are frequently cleaned, prior to plating or finishing, by immersion in dilute acid—a process known as "pickling." In the pickling process it is necessary to exercise care to prevent the acid from attacking the metal proper. Recently however, it has been discovered that the addition of a small amount of ichthyol or ichthyol sulfonate to the pickling bath will prevent undesired attack on the metal.—*A. E. B.*

Precious Metals from Obsolete Telephone Equipment

A BIT of precious metal constituting the contact point on a spring may seem to be an insignificant item in a system so complex as the modern telephone plant. From a monetary standpoint the reclaimed value of such a contact point would seem so inconsequential to the average person



A pile of gold from old phones

that one could hardly imagine that it would be profitable to salvage such tiny bits of metal from the bulk of obsolete telephone equipment that arrives at the Western Electric Hawthorne Works every year. However, science comes to industry's aid and each year from 8000 to 10,000 troy ounces of precious metals, largely gold and platinum, are reclaimed at a real economy to the telephone companies. This is another example of the scientist applying his knowledge to industry's problem.

A fully equipped laboratory has been especially designed to handle the precious metal. The contacts which cannot be used in the condition they are received from the field are put into a solution of nitric and hydrochloric acid. The gold is precipitated from the solution as gold sponge after suitable manipulation by sodium oxalate. The platinum is precipitated by ammonium chloride as ammonium chloroplatinate, which is subsequently ignited to form sponge platinum.

The reclaimed metals are alloyed in proportions suitable for the contact alloy requirements, and made into tape and wire for use in the manufacture of new contacts.

In addition to the precious metal returned from the field, approximately 2000 troy ounces of gold are recovered each year from gold plated parts, spent gold plating solutions, and rinse water from gold plating operations.

The Truth About High-Altitude Flight

(*Continued from page* 223)

since water boils at 120 degrees, Fahrenheit, when at an altitude of 50,000 feet. The boiling points of anti-freeze mixtures are lowered accordingly.

Special engines for high-altitude work will be developed as soon as there is a demand, but until that time arrives, most of the high quality American engines can be "revamped" to serve the purpose with the same safety as at sea level.

However, what good is the best engine without an equally efficient propeller for transformation of power into speed? Therefore, the problem of propulsion is of as great importance as the pressure cabin and the engine for flying in the thin air of high altitudes.

A PROPELLER designed for conventional flying in the relatively dense air close to sea level has its blades set at a fixed angle or pitch, to balance the power of the engine at a certain speed of the plane. When this plane climbs to higher levels and air gradually becomes thinner, the propeller loses some of its grip or pulling power. If the engine had not lost some of its power as well, it would react by revolving the propeller faster. But the plane loses speed continuously as the altitude increases, until the maximum height or absolute ceiling is reached, at which the propeller pull cannot overcome the resistance offered by plane and gravity.

However, an altitude plane delivering constant power would have revolved this same propeller with gradually increasing speed as the air became thinner, to make up for the loss of grip. Higher speed and ceiling would have been the result. Unfortunately, the increase of engine and propeller speed is very limited for reasons of safety, efficiency, and economy. Thus the conventional fixed-pitch propeller is unsuitable for flying at altitudes above 30,000 feet with engines of constant power. But a propeller made for flying at high speeds at 50,000 feet would not allow the engine to revolve at proper speed in the dense air at sea level to deliver its normal horsepower, and to attempt a take-off would be dangerous or impossible. The solution, therefore, is a propeller on which the angle of the blades can be changed to get the proper grip on the air at any altitude and within nominal engine revolutions.

The change in pitch during the climb to the upper flight lane may be either automatic according to density or manually operated by the pilot by keeping the engine revolutions within a certain range at fixed throttle. If the engine runs too fast, a twist of a wheel in the cabin increases the pitch of the air screw and the additional grip brings the engine speed back to normal. In horizontal flight the pitch remains at its best setting and no further adjustments are necessary.

Thus we have given a few examples of the difficulties to be overcome. There are others, and new ones probably will turn up during the test period, but pioneering is always confronted with obstacles which generally are defeated as they come along.

Now the questions arise: What speeds can really be obtained with propeller propulsion in the thin air of the stratosphere? Is this gain worth the effort and labor described in the preceding paragraphs? The resistance of the plane not only varies in proportion to the density of the air but also by the square of the speed. Inversely, therefore, the speed of the plane in thinner air should increase by the square root of the density ratio and a plane flying at an altitude of 50,000 feet, in 6.5 times thinner air, should be about 2.55 times faster than at sea level. However, this ideal result cannot be reached because of the changing relations of different factors with altitude. This is one reason why speeds of altitude planes are generally greatly exaggerated. Real conditions are more closely approached if the speed calculations are based on the assumption of constant power and this shows us that for every plane and every altered condition, be it wing surface or engine power, a certain altitude exists where speed and range simultaneously reach a maximum. This altitude of maximum speed and range of a plane with constant power lies close to its maximum ceiling, generally about 4000 to 6000 feet below, where the lift/drag ratio of the plane is also at maximum.

In comparing speeds of conventional and high-altitude planes it is essential to consider two planes with similar payloads, one designed for high performance at sea level and the other with altitude equipment and therefore of higher gross weight, designed for best performance at high altitudes. Otherwise we arrive at figures which are not impartial.

Calculations based on the above considerations show a top speed increase of 60 percent and a cruising speed increase of 50 percent at 50,000 feet over speeds obtained at sea level with a conventional plane designed for high speed.

IT is obvious therefore that a speed increase of about 50 percent is the maximum gain that can be expected for commercial aviation with high-altitude equipment and propeller propulsion. At first glance this figure is not very impressive, especially if one has the published speeds of 500 miles per hour and more in mind. However, if we consider the possibilities of doubling the non-stop range of the plane by flying at the most economical speed we can vision the influence that high-altitude flying will have on commercial air transportation for long range service.

For short ranges, up to 700 miles, the gain accomplished by high-altitude flying would be very small because of the time lost during the climb to the flight lanes at 50,000 feet. This again shows that high-altitude planes will not supplant our present day aircraft for short and medium ranges, but rather will become valuable supplementary equipment to the air lines for long-distance flying of mails, parcels, and express, with passenger transportation to follow in due time.

Altitude planes most probably will serve in air transportation just as express trains and fast steamers serve in surface travel. As soon as high-altitude flying becomes a reality, air lines can operate between America and Europe, as well as between other distant points where intermediate landing and refueling stations other than existing islands are not available, or could be established only with exorbitant cost.

Besides being faster, high-altitude flying may become safer and more regular than sea-level flying across oceans and deserts due to the absence of "weather" in the stratosphere. In flying over oceans the pilot will not have to fight his way through storm and ice-forming clouds, with the surface of the water only a few hundred feet below, but will fly at ease in smooth air and continuous sunshine during the day and brilliant starlight at night with the surface of the ocean miles below.

IF engine trouble should develop, which even at the present early stage of development is a very rare occurrence on a seven to twelve hour flight at cruising speed, the pilot could glide with a "dead" engine about 135 miles in any direction and with the help of his radio could probably find a steamer near which to make a safe landing. The gliding time for such a distance is approximately 80 minutes.

The high-altitude plane, with its wheels tucked away in the wings, or equipped with special landing gear, will be perfectly safe to land on water. The double-walled airtight cabin, of stainless steel or duralumin, will keep the plane afloat for a long time. For emergency landings on water a special exit has been provided in the convex top of the observation dome which is high enough above the water line to keep the waves out and to provide the cabin with fresh air until the plane is hauled aboard ship.

In flying over land, the altitude plane will not only be safer but will also have a higher factor of reliability in flying to schedule on account of the absence of changing weather, fog, and other meteorological disturbances in the stratosphere. The possible necessity of "blind flying" is limited to a short time after take-off and before landing.

Irregularity in service is usually very costly to businesses and individuals who patronize air transportation either with mail and packages or as passengers. It is also costly to the air-line operators, who not only have to keep their flying equipment on the ground, but generally lose disappointed customers for future business. With this in mind it is easy to understand the importance of scheduled service for successful competition with steamships and railroads. Sea-level flying depends on weather to a great extent, and as the possibility of bad weather along the route increases with range, it is a logical conclusion that transoceanic air service at sea level will lack the regularity necessary to compete successfully with our fast express steamers, except on a very limited scale.

All the difficulties of long-distance flying at sea level do not exist at high altitudes and as soon as the altitude plane is out of the development stage the air lines will have a speedy and dependable supplement to the present equipment for long-distance operation. Regular, dependable service, combined with a speed increase of 50 percent over sea-level flying, which can be offered by high-altitude flying, should greatly increase the use of airplanes as mail and express carriers. Passenger service is bound to follow as soon as the safety and smoothness of flight in the "weatherless" region of the stratosphere has been demonstrated.

COMMERCIAL PROPERTY NEWS

Conducted by SYLVESTER J. LIDDY

Member of the New York Bar

Patent Office Catching Up

A NEW record in disposing of patent applications was set by the Patent Office during the past fiscal year, according to the annual report of Commissioner of Patents Thomas E. Robertson, issued by the Department of Commerce.

Disposals passed the 100,000 mark for the first time, the total being 100,960, a gain of 7553 over the previous peak reached in the 1931 fiscal year, it was pointed out. The new record was set in catching up on work in arrears, for the actual number of new applications received declined from the 1931 figure.

As a result of the policy of giving a special status to applications for patents likely to lead to the investment of capital and the employment of workers, several million dollars were invested and employment given to several thousand persons, Mr. Robertson showed in his report. The policy was adopted because of a realization that delay in reaching applications for examination is a frequent drag upon industrial activity.

The reduction in the number of applications awaiting official action has resulted in greatly reducing the time applicants have to wait for official action, it was pointed out. Thus, two years ago, out of 63 examining divisions, only three were under six months, 54 were over seven months, 48 were over eight months, and 33 were over nine months, whereas at present two divisions are under two months, eight under three months, 28 under four months, 37 under five months, and all under six months. The progress made is also evident from the allowance of over 65,000 applications and the grant of 52,562 patents during the year, as compared with 44,317 granted the year before, an increase of 18.6 percent.

"Germania" a Geographical Mark

IN a recent decision, First Assistant Commissioner Kinnan held that Germania Tea Company, of Minneapolis, Minnesota, is not entitled to register the term "Germania", under the Act of 1905, as a trademark for a medicine, since it has merely a geographical significance.

In his decision, after noting applicant's argument that the Latin language being a dead language it is improper to consider the word as a name in a foreign language and that the word is used as a fanciful and arbitrary name for the product, the First Assistant Commissioner said:

"It is noted that in Funk & Wagnalls New Standard Dictionary, Edition of 1927, the word 'Germania' appears as a regular word and is defined as meaning 'Germany, especially as personified.' It is believed to the average purchaser the word suggests Germany or that the goods had their origin in that country or among people of that nationality. In the absence of a showing that the word means anything more than a geographical locality it must be held its registration as a trademark under the 1905 Act is barred by statute."

MR. LIDDY will be pleased to answer the inquiries of our readers who may desire information relative to the various subjects reported in his department.
—The Editor.

Review Refused of Steel Tube Patent Case

REVIEW of a patent case relating to the manufacture of steel tubing was denied by the Supreme Court of the United States recently, in the case of General Tube Co. versus Steel & Tubes, Inc.

Two patents are involved, Johnson Patent No. 1388434, relating to what is claimed to be a new and improved method and apparatus for butt-welding thin gage tubing and Johnson Patent No. 1435306, for the product of the process.

The petitioner pointed out in its brief that the patents relate to the manufacture of steel tubing by curving up a flat steel strip to the form of a tube having a lengthwise seam and then welding the seam electrically in a particular manner—the use of electricity as the medium for heating the tubing rather than utilizing a flame produced by burning oxyacetylene or other gas.

A Federal district court held the patents valid but limited their application to operations conducted in excess of 30 feet per minute and decided the patents were not infringed when operated under 30 feet per minute.

The petitioner appealed to the Supreme Court from a reversal of the district court by the Circuit Court of Appeals for the Third Circuit which held that the patents are valid at all speeds, and hence infringed.

Vending Machines Show Improved Sales

SALES of mechanical vendors and coin-operated amusement machines have held up well during the depression. A large manufacturer and distributor of cigarette vendors has just entered into a contract with an oil company to supply several thousand machines during the next few months. Another contract with a tobacco company calls for delivery of cigar vendors.

A mid-western manufacturer of coin-operated amusement machines has recently expanded his plant to four times its original size to take care of incoming orders.

Recent developments in the coin-operated machine industry include a visible slug detector; a coin-operated machine that brushes off patrons' clothes, designed for railroad stations; coin controlled pool tables in Germany and installation of ticket automats for street car and bus stops in Paris on the lamp posts of "stops" or loading platforms.—(Department of Commerce.)

Trade Commission's Work in 1932

MORE than 20,000 false and misleading advertisements were either discontinued entirely or revised to check fairly with the truth last year as a result of the Federal Trade Commission's campaign against fraudulent advertising, it is estimated in the Commission's annual report for 1932.

While the amount of money saved the public by this branch of the Commission's work runs into large figures, the actual cost of the work for the last fiscal year was only 23,400 dollars or an average of $57.63 a case.

Hundreds of advertisers of fake products have been driven out of business through co-operation of publishers with the Federal Trade Commission in its campaign against fraudulent advertising, and thousands of otherwise honest business men, who had habitually used exaggeration in their advertising assertions, have revised their "copy" and now find that it pays to tell the truth in advertising.

Regarding the different types of false advertising found, the Commission, in its annual report, says its investigations have disclosed frauds of many kinds. The worst are perpetrated by those who prey on those of their fellows who are willing to try anything to get relief from pain or the handicap of illness. Millions of dollars are spent annually for preparations worthless or of doubtful value but advertised as being effective.

Some chemists, some "cosmeticians" and others, who are looking for easy money, sell preparations which will not always stand up under careful scientific analysis. A 'wrinkle oil' was found to consist of castor oil with a few drops of perfume, put up in 2-ounce bottles of pleasing shape, with beautiful labels, for $2. For fat people, many reducing creams are offered, and numerous vendors advertise magical results, all of which are false and misleading, for there is no cream that will reduce fat by mere application. Some vendors offer the identical cream as a tissue-builder or flesh food to enable skinny folk at will to build up flesh on the neck, the arms or legs, the back, the bust, or wherever they crave it, yet there is no known cream that will build tissues or feed flesh.

Having perfected the form divine by either reducing rolls of fat or rounding out the graceful curves, perhaps the color of the hair is not quite pleasing, and to remedy this there are tonics galore to re-

move dandruff and thicken the hair and cause it to grow, and dyes of many kinds to impart a color that might make one appear more youthful, if the lines of the face and the color of the skin did not belie the copper tint that displaced a natural and distinguished gray.

False advertising cases are investigated and developed for the Commission by its Special Board of Investigation which considers all such advertising in newspapers, magazines, and on the radio that is brought to its attention by reference, complaint or otherwise.

Radio Clock System Patented

A SYSTEM of operating clocks by radio waves broadcast from a central station has been patented by Clyde F. McCann of San Francisco, to whom the United States Patent Office has issued letters patent No. 1881818. It is claimed that this system, utilizing Hertzian waves, transmitted from a central station having a master control clock, can hold all other clocks adequately equipped within its reception range to precision timing. The superiority over clocks now regulated by electrical wires presumably would result from the fact that radio waves travel at the speed of light, or 186,000 miles per second, thus eliminating the "drag" or "time lag" on wires.

Insecticide Mark Registrable

FIRST Assistant Commissioner Kinnan recently held that The Lewy Chemical Company of New York, New York, is entitled to register, under the Act of 1905, as a trademark for insecticides, a mark consisting of the representation of a lozenge in doughnut form above which is the notation "Moth-Gas" together with the representation of a gas emanating from the lozenge, if applicant disclaims the representation of the goods. The ground of the decision is that the mark as a whole is not merely descriptive of the goods.

In his decision the First Assistant Commissioner said:

"It is thought, however, that the mark when viewed as a whole, although highly suggestive, is not merely descriptive. The goods are not associated with nor do they give off any such smoke as is illustrated in the mark; and the words used as they are, partly obscured by gas fumes, give to the mark a degree of fancifulness which it is deemed justifies its registration. The term 'Moth-Gas' is not shown to have been previously used by others to designate any kind of a gas for killing moths, and it is even uncertain whether the applicant's goods yield a gas at all. In view of these facts it is thought that if the applicant disclaims the representation of the goods the mark should be registered."

New Aerial Cuts Radio Interference

A METHOD of eliminating radio interference caused by an airplane's own engine is covered in U. S. patent No. 1893-287, granted recently to C. Francis Jenkins, Washington inventor who holds many patents in the television, motion picture and other fields.

"It has been customary," Mr. Jenkins explained, "to suspend a wire under the plane with a lead weight, a lead 'fish,' attached to the free end thereof to hold it steady, and as nearly vertical as possible; or to fasten the antenna to a vertical mast carried by the plane. Antennas have also occasionally been fastened along the leading edge of the wings and from the wing tip to tail structure.

"All such antenna locations have serious interference from engine ignition radiation. For this reason costly shielding of the magnetos, the spark plugs, and high tension leads must be employed to avoid ignition noises in the exposed antenna preventing voice reception aboard the plane, and seriously interfering with code reception."

Mr. Jenkins found that electrical high-tension radiation from the engine ignition system is spherically radiated, and envelops the plane, and by exploration he has discovered that a radiation-free zone exists aft of the plane which probably results from absorption by the metal parts of the plane fuselage creating an electrical cone-shaped shadow free of interference behind the plane spreading out from a point directly behind the engine.

The Jenkins invention therefore holds the antenna axially in this zone by unreeling the antenna and permitting it to fly aft from the tail structure. A small celluloid ball or balsa-wood "fish" is attached to the end of the antenna so as to keep it horizontally taut in the electric shadow in the wake of the plane. The antenna in this position does not pick up any radiation from the ignition system of the engine.—*Science Service.*

"Radium" Water

THE Federal Trade Commission has ordered Neil M. Jones and Robert D. Emery, Los Angeles, trading as American Radium Products Company, to discontinue representing that water drawn from the lined water jar sold by them and heretofore designated "The Radium Spa" has any therapeutic or curative value for any bodily ailment or disease.

The respondents had waived hearing on the charges set forth in the complaint and consented that the Commission serve upon them an order to cease and desist.

The Title to Inventions

A PATENT attorney of Washington, D. C., Mr. Carl Fenning, presented a paper before the American Institute of Chemical Engineers recently, reviewing the legal aspects of certain problems in the ownership of inventions between employers and employees. In general, these relations may be divided into the following:

1. Inventions having no bearing upon the employee's duties and made outside of office hours are the property of the employee, and the employer has no interest in them. Solomans v. U. S. 137 U. S. 342.

2. Inventions arising out of or made in connection with the employee's duties and incidental thereto by an employee whose duties do not include the conducting of research or inventive work. Here the employee retains the title to the patent, but the employer is entitled to a shop right or a non-exclusive license. Gill v. U. S. 160 U. S. 426.

3. Inventions made by an employee in connection with and within the field of his work, where his duties include the conducting of research and inventive work.

(a) Where the employee was specifically assigned to the task of making the invention, the entire property right to the invention vests in the employer. Standard Parts Co. v. Peck 264 U. S. 52.

(b) Where the invention is within the general field of employee's research and inventive work, but where he was not specifically assigned to develop the particular invention, the courts generally have held that the patent and invention do not belong to the inventor.

The only safe arrangement, concludes Mr. Fenning, is to have a definite written agreement with all employees covering all inventions relating to the specifically defined field in which the employer is operating or interested, and whether made during the term of employment or afterwards.—*Chemical and Metallurgical Engineering.*

Stocking Patent Upheld

IT was announced recently that the Gotham Silk Hosiery Company, Inc., had won its suit against the Artcraft Silk Hosiery Mills, Inc., of Philadelphia for infringement of a patent on the manufacture of Gold Stripe stockings known as "adjustables." The patent, issued to Roy E. Tilles, covers the manufacture of a single pair of hose which can be adjusted to any size.

A decision handed down by Judge Nields of the United States District Court of Delaware holds that "the defendant paid the Tilles patent the tribute of extremely close if not absolute imitation. . . .Defendant's 'Tri-Length' stocking clearly infringes the Tilles patent."

Cartoon Trademark

IT was recently held by First Assistant Commissioner Kinnan that Percy L. Crosby of McLean, Virginia, is entitled to register, under the Act of 1905, as a trademark for "Drawings for Reproduction, and Comic Strips or Cartoons", the notation "Sooky."

In his decision the First Assistant Commissioner noted that the examiner of trademarks made no objection to registering the mark for "Comic Strips or Cartoons" but held it was not registrable for "Drawings for Reproduction" since the notation was but the name of the drawing and therefore merely descriptive.

He then pointed out that the record shows that the applicant makes drawings each specifically different from the others, but all having a certain similarity in the representation of a small boy called "Sooky" and it appears that a series of these drawings are made and sold, each one of which bears the name "Sooky."

Then, after referring to the cases holding that a title of a book may not be registered and decisions as to the "Mutt and Jeff" trademark, he said:

"It is considered proper to conclude that the applicant is seeking registration of his mark for a series of drawings of the 'Sooky' character which are intended to be and are sold in commerce. It is held that the applicant who, so far as the record shows, originated and was the first to use this notation, is entitled to its registration as a trademark for the goods described as 'Drawings for Reproduction'."

Books SELECTED BY THE EDITORS

RADIO SERVICING COURSE

By Alfred A. Ghirardi and Bertram M. Freed

THIS book has been prepared especially for service men now active in the radio field, and for those who are about to take up such work as a vocation. It is by no means to be considered as a source of a complete education in the subject, but rather as a supplementary mine of information on radio-set testing equipment and methods of using it. The authors presuppose that the reader has an elementary knowledge of electrical and radio theory and knows something about radio-set construction and operation. Standard manufactured trouble analyzers are illustrated by photographs and diagrams; other drawings give suggestions from which the reader may "roll his own."

It is to be regretted that a book with such a valuable content should be published with such poor illustrations as are to be found here. Some of the line drawings are so poorly executed and reproduced that the reader must at times guess at what is meant to be conveyed. Further, while one does not look for literary merit in a technical book, careful editing of copy before publication will often work wonders in making a subject easier to grasp.—$1.65 postpaid.—*A. P. P.*

RADIO PHYSICS COURSE

By Alfred A. Ghirardi, E. E.

SELDOM does this reviewer fail to take publishers' "blurbs" on book jackets with the proverbial grain of salt, and sometimes with a whole shaker-full. Such was the inclination when he read "This is the one radio book which explains everything," on the jacket of the work before him. But reading further dispelled the original inclination. The 972 pages between the covers of this book do, as nearly as is possible in language understandable to the layman, cover the whole field of radio, and also television, photoelectricity, and talking movies.

This book (second edition, revised and enlarged) is expressly intended for use as a text for radio courses in technical high schools and the like, but it will be found valuable to anyone who wants to obtain a usable, working knowledge of the subjects covered. Only the simplest of arithmetic is necessary in order to follow the author as he progresses from fundamentals to practical applications. We cannot speak too highly of the scope of this book and of the way in which the material is presented, both for continuous reading and study, and for ready reference. But here again poorly reproduced illustrations detract from appearance. If ever a third edition is published, it is to be hoped that both the halftones and line cuts will be improved. It is a shame that the illustrations do not maintain the same high standard which the author has set in the preparation of the vast quantity of material that makes up the text.—$3.70 postpaid.—*A. P. P.*

STORAGE BATTERIES

By Crocker—Arendt—Kuns

THE principles of action, construction, and maintenance of lead and non-lead batteries and their principal commercial applications. Starting with the fundamental design and manufacture of all types, the outline carries through the care of batteries, especially automobile starting and lighting types, finally describing the building and repair of the types previously mentioned. A book for self-study, clear and understandable in diction and practical as the long experience of the authors would indicate.—$1.65 postpaid.

STANDARD HANDBOOK FOR ELECTRICAL ENGINEERS

Frank F. Fowle, Editor-in-Chief

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FORGING

By Bacon-Johnson

PRACTICAL instructions for hand forging wrought iron, machine steel, and tool steel; drop forging and heat treatment of steel including annealing, hardening and tempering. For many years the authors have had experience not only in practical work but also in the field of instruction and thus can cover the many pitfalls and traps which are bound to befall the learner. It seems that every possible phase of the art has been fully explained both in text and by diagram. A splendid little book.—$1.40 postpaid.

INTRODUCTION TO PRACTICAL ASTRONOMY

By Dinsmore Alter, Prof. Astron., Univ. Kansas

THIS is not what is commonly meant by an "introduction" to astronomy (that is, a textbook) but is a series of laboratory exercises in practical astronomy, the subjects being such as the study of the vernier, study of time, celestial coordinates, and determining latitude.—$2.20 postpaid.—*A. G. I.*

SCIENCE IN THE CHANGING WORLD

By Julian Huxley, Bertrand Russell, J. B. S. Haldane, Oliver Lodge, and others

FROM these chatty, informal short chapters which were based on a series of radio talks delivered in England, the reader will pick up some actual science and a great deal more of its process of reasoning. This is a symposium by ten persons of widely different points of view concerning the value and nature of things scientific.—$2.15 postpaid.—*A. G. I.*

THE NATURE OF THE PHYSICAL WORLD

By A. S. Eddington, Prof. Astron., Univ. Cambridge

MOST readers of semi-popular books will recall the fame which this book won a few years ago. It became a scientific best-seller and so insistent has the demand for it been that it is now reissued at a popular price. That it has not gone the way of many other ephemeral volumes of similar scope speaks much for the lasting quality of its contents. The scope is the newer physics.—$2.15 postpaid.—*A. G. I.*

CHEMICAL WAVE TRANSMISSION IN NERVE

By A. V. Hill, F. R. S.

IN this little book the world's ablest physiologist (as recognized by most scientists) gives an account of his ex-

periments on the nature of nerve stimulus. It debunks the claims of those who would have it that nerve stimuli are something mysterious—almost supernatural. A. V. Hill has proved them to be quite as natural as anything else, though very delicate. The reader should have some background in biology.—$1.40 postpaid.—*A. G. I.*

THE TIDES OF LIFE

By R. G. Hoskins, Research Associate, Harvard Medical School

THE endocrine glands' function in bodily adjustment, just what and where they are, how they affect physical and mental attributes, are here explained in as non-technical language as seems possible. It is true the average person will probably have to consult a dictionary frequently to understand certain technical words the use of which cannot be avoided, but the general construction and development of each part is delightfully clear, written as it is in very readable language. Each gland is treated in a separate chapter based on the first chart we have seen which locates them all in the body. So much quackery and misinformation has been handed out to the public, we believe this clear, authoritative outline will be popularly received and perform a real beneficial service to a large public.—$3.65 postpaid.

ONE THOUSAND NEEDED INVENTIONS

By Raymond F. Yates

ANY list of this kind must necessarily include some items which have relatively small significance, but since this book was published we note several of the suggestions already have become realities. It would seem that invention would most naturally spring from an actual development rather than from a suggested idea, yet there are many who seem to be interested in lists of this kind, whatever the reason.—$1.65 postpaid.

JANE'S FIGHTING SHIPS 1932

Oscar Parkes, Editor

IT would seem that the past year would not register much information concerning battleships because of suspended building programs, disarmament discussions, and so forth, yet the fact is that there have been some quite significant attainments, for in some instances like the reconstruction of the *U. S. S. New Mexico* type, the verification of rumors and the tangible evidence of lessons learned by experience may be of even greater interest than new construction. Unusually fortunate aid from official sources makes the present volume even more thorough than in previous years, though the standard previously set makes further attainment seem almost impossible. This work is the recognized authority throughout the world and it is full of interest even for the layman.—$15.00 postpaid.

JANE'S ALL THE WORLD'S AIRCRAFT 1932

C. G. Grey, Editor

BY one of those curious twists in the order of affairs, the very fact that disarmament has been so extensively discussed has pushed ahead new and improved designs of warships so that ministries might know what were the best types that they would be allowed to order under any possible scheme of disarmament. Hence despite the scarcity of money, 1932 was singularly active in air affairs, especially in heavy plane transport and bombing designs. Just what these were, all over the world, has been accurately and with much detail collected in this 22nd yearly issue. It stands as the monumental and unquestioned authority in the field of aviation bibliography.—$15.00 postpaid.

BRASSEY'S NAVAL AND SHIPPING ANNUAL 1933

THE first half of this reliable old manual of 47 years' standing contains, as usual, special articles by writers of authority which make the work unique as an open forum for the discussion of maritime affairs. A summary which follows contains an epitome of these essays. The balance is a collection of valuable statistics covering both naval and mercantile affairs. Numerous well taken photographs of ships, outlines of warcraft with profiles of merchant ships, make a most interesting study. In fact each year seems to bring more to engage attention and this year, despite economic conditions, the editors have bettered last year's high standard. A reference which everyone interested in nautical lore should have at his elbow.—$5.50 postpaid.

100,000,000 GUINEA PIGS

By Arthur Kallet and F. J. Schlink

ACCORDING to the authors of this book some of the best-known food products, dentifrices, and cosmetics, are unfit for human use. The manufacturers foist them on us by means of unscrupulous advertising and we test them out, hence we are the "100,000,000 guinea pigs." If after using a product we don't die, it proves that it was fit to use. If we die, it shows that something was wrong with the product. The products which are "treated rough" in this book are openly named—there is no evasion, no circumlocution. You don't have to guess whether the most terrible toothpaste is one you hear about over the radio. Obesity cures catch it, also. So do lots of cherished products. This book will stir up a lot of fuss and be widely read. Whether you will like its contents or not will depend, probably, on your disposition—on whether you like your reading hot or cool. The authors are crusaders. Both are connected with Consumers' Research, an organization which, it is gladly asserted, has done a lot of good. One of them wrote the book "Your Money's Worth," which had a wide sale. But crusaders usually work themselves into a certain state of mind. First they discover conditions that are bad. And then, not content with exposing the facts as they are, they must exaggerate them, surround them with horror, sensationalize them, dramatize them. Except on moron readers this usually produces just the opposite of the anticipated effect. However, there are in this world many more gullible gumps who are game for the purveyors of punk products than cool calm thinking persons, and so a book written in the tone of this one may, after all, be the only way to get at them. Intelligent readers too (such as ours!) may find things in it which are well worth reading—with discernment.—$2.15 postpaid.—*A. G. I.*

THE ABOLITION OF UNEMPLOYMENT

By Frank D. Graham, Prof. Economics, Princeton

A SYSTEM of restricted barter is advanced as a logical solution to the gravest problem of these times. This plan would not interfere with natural markets nor endanger the jobs of those already employed. Rather would it enhance regular employment by acting as a spur to industry. It is a definite plan of action and a concise remedy for a social crisis. An interesting and timely study written in entertaining style.—$2.15 postpaid.

PATTERN MAKING

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